

Simo Kalatie – Helinä Laakkonen – Eero Töölö

Indicators used in setting the countercyclical capital buffer



EUROJÄRJESTELMÄ
EUROSYSTEMET

Bank of Finland Research
Discussion Papers
8 • 2015

Indicators used in setting the countercyclical capital buffer

Simo Kalatie, Helinä Laakkonen, Eero Tölö*
Bank of Finland

16.3.2015

Abstract

According to EU legislation, the national authorities should use the principle of 'guided discretion' in setting the countercyclical capital buffer (CCB), which increases banks' resilience against systemic risk associated with periods of excessive credit growth. This means that the decision should be based on signals from a pre-determined set of early warning indicators, but that there should also be room for discretion, as there is always uncertainty associated with the use of early warning indicators. The European Systemic Risk Board (ESRB) recommends that the authorities use the deviation of the credit-to-GDP ratio from its long term trend value (credit-to-GDP gap) as the primary indicator in setting the CCB. In addition, designated authorities should use in their decision making indicators that measure private sector credit developments and debt burden, overvaluation of property prices, external imbalances, mispricing of risk, and strength of bank balance sheets. Based on an empirical analysis of data on EU countries and a large assortment of potential indicators, we propose a set of suitable early warning indicators for each of these categories.

*Corresponding author. Address: Bank of Finland, Financial Stability and Statistics Department, P.o.Box 160, 00101 Helsinki, Finland. Email: eero.tolo@bof.fi. The views presented in this article are those of the authors and do not necessarily represent the views of the Bank of Finland. The authors would like to thank Mikael Juselius and Tuomas Peltonen for valuable comments given in the Annual Meeting of the Finnish Economic Association, Esa Jokivuolle, Karlo Kauko, Hanna Putkuri, Katja Taipalus, Jouni Timonen, Jouko Vilmunen, and Matti Virén for useful comments and proof-reading the manuscript, and Timo Virtanen for research assistance. Any remaining errors are the authors' alone.

1 Introduction

The countercyclical capital buffer (CCB) proposed by the Basel Committee on Banking Supervision (BCBS, 2011) aims to mitigate excessive credit booms and the related pro-cyclicality in the financial system. CCB builds on the key element in the traditional banking regulation, the minimum capital requirement that stipulates bank to maintain at least a minimum amount of loss absorbing capital. The idea is to increase the banks' capital requirements when vulnerabilities related to the credit cycle are increasing, e.g. when there are signs of excessive credit growth or a credit-driven asset price boom. Setting the CCB increases the banks' resilience against potential future losses in stressed periods. It could also dampen credit growth by cutting down supply of credit, as the banks need to commit more of the owners' capital against risky assets. Furthermore, releasing the CCB when the credit cycle is in decline decreases the chance of credit crunch and may enable banks to provide lending to profitable investments also in an impaired macroeconomic environment. In order to set the countercyclical capital buffer at the right time, the macro-prudential authority needs to identify the increasing cyclical vulnerabilities.

The CCB was recently implemented in the EU's capital requirements directive (CRD IV 2013/36/EU). According to the CRD IV, the designated authority takes into account, first, a buffer guide defined in the directive, second, the guidance and recommendations issued by the European Systemic Risk Board (ESRB), and third, any other variables that the designated authority considers relevant for addressing cyclical vulnerabilities. The buffer guide is the deviation of the ratio of credit-to-GDP from its long-term trend calculated following the methodology of BCBS with one-sided Hodrick-Prescott filter and smoothing parameter $\lambda = 400,000$ (henceforth denoted as credit-to-GDP gap). Recently, ESRB published a recommendation on operationalizing the countercyclical capital buffer (ESRB, 2014), which is based on the results of the empirical study executed by the ESRB expert group on countercyclical capital buffer (Detken et al., 2014). ESRB recommends the authorities take into account and regularly publish data on other variables that may complement the credit-to-GDP gap for signaling the build-up of system-wide risks related to excessive credit growth. The indicators should include measures of credit developments, measures of potential overvaluation of property prices, measures of private sector

debt burden, measures of external imbalances, measures of potential mispricing of risk and measures of the strength of bank balance sheets. ESRB recommends that the authorities have at least one early warning indicator (EWI) from each of these categories to support the decision on CCB, and while they give some suggestions what these indicators could be, it is not so clear for all the categories. For example, the leverage ratio suggested for the category 'measures of the strength of bank balance sheets' is not found to be a useful indicator in the ESRB's own empirical analysis (Detken et al., 2014). If the ESRB recommendation is followed by national authorities as suggested by the EU directive, it will be valuable to have a clear view of the best indicators in each category.¹ Hence, our empirical work continues that of Detken et al. (2014) and aims to find the best EWIs for each of the six indicator categories given in the ESRB recommendation. In the end, we find suitable indicators for each of the categories although the indicative power of the indicators vary considerably.

The empirical analysis is performed with an unbalanced panel data of the 28 EU countries and quarterly data for the period from 1970Q1 to 2012Q4. The indicators that signal vulnerabilities that may lead to a banking crisis are identified based on the evolution of indicator values during tranquil times and during a pre-crisis horizon 3 to 1 years prior to the banking crisis.² Hence, we aim to explain a pre-crisis dummy variable, which equals 0 for tranquil quarters and 1 for the pre-crisis quarters. One of the often debated issues in these type of studies is the definition of banking crisis, and different authors typically end up with unequal crisis events and differences in the crisis dates. We mainly use the same banking crisis dataset as Detken et al. (2014) but the results are carefully cross-checked against the alternative crisis datasets by the ESCB Heads of Research (HoR) (Babecky et al., 2012) and Laeven & Valencia (2012) (LV).

We consider a set of 50 macro-financial or balance sheet based indicators and various transformations thereof. The set of indicators is to most part based on what has been identified useful in earlier studies. Additionally we include indicators

¹The ESRB recommendation has been followed at least in the Finnish legislation on the counter-cyclical capital buffer.

²Detken et al. (2014) use 5 to 1 year pre-crisis horizon while the 3 to 1 year has been advocated by many, e.g. Behn et al. (2013). To probe the impact on the results due to the pre-crisis horizon selection, we also calculate results with 1 quarter pre-crisis horizon that precedes the banking crises by n quarters for each $n=1,2,\dots,20$ following the approach in Drehmann and Juselius (2014).

that have conceptual motivation but have to our best knowledge not been tested as EWIs of banking crises. The new indicators include a proxy for high-yield corporate bond spread, CBOE volatility index (VIX), cross-border loans to GDP or assets, benchmark government bond yields, household interest expense burden, and two balance sheet indicators based on liquidity and short-term funding.

Following the methodology used by Drehmann and Juselius (2014) and Detken et al. (2014), we measure the performance of EWIs based on the receiver operating characteristic (ROC), which is the mapping that specifies the trade-off between false alarms and missed crises for all possible threshold values of the EWI. Hence, we use the area under the ROC curve (AUC) as measure of the indicators' performance. In addition, we require that the indicator has some explanatory power in a univariate logistic regression. While earlier literature has shown that combining several indicators into a composite indicator may improve the signaling power (Behn et al., 2013; Anundsen et al., 2014), we mainly look at the indicators individually as we are interested in finding simple robust indicators for each of the categories in the ESRB recommendation.³ However, we prefer indicators that have strong potential to contain complementary information on vulnerabilities compared to the benchmark indicator credit-to-GDP gap and are hence more qualified to be used as additional indicators in setting the CCB. To achieve this goal, we estimate a bivariate logit model, in which the pre-crisis dummy depends on the EWI and credit-to-GDP gap. It is then required that the EWI has a statistically significant coefficient with the correct sign.

Regarding the indicators to be assigned into the ESRB's six vulnerability categories, we find the following results. Earlier literature has found private sector credit-to-GDP gap to be the best single indicator in predicting banking crises. We also find credit to GDP ratio based indicators to be the best and work significantly better than indicators measuring pure credit developments. According to our results, the trend gap, 3 year difference and deviation from 5 year moving average in credit-to-GDP perform equally well irrespective of whether the credit is total private credit, total bank credit or credit to households. For the measures of credit developments category we therefore recommend some transformation of the household

³Aikman et al. (2014) suggest that simple indicators often out-perform more complex alternatives due to greater robustness when there is uncertainty.

credit to GDP and bank credit to GDP to be used.

For the measures of private sector debt burden category, differences and trend gaps in household debt to disposable income ratio signal vulnerabilities about equally well as the indicator in previous category where the denominator had GDP instead of disposable income. We also find differences in household debt service ratio and total private sector debt service ratio to be informative especially for shorter prediction horizons. We recommend some transformations of household debt to income ratio and debt service ratio to be used as an indicator in the private sector debt burden category. The results also indicate that a simple interest expense to GDP ratio can work as a useful indicator, so we recommend this type of proxy to be used if debt service ratio is not available.

While all of the indicators in the measures of potential overvaluation of property prices were quite informative, our results suggest that transformations of the house price to income ratio outperform transformations of the house price to rent ratio or real house prices. Hence, we recommend at least some transformation of the house price to income ratio to be monitored.⁴

Measures of external imbalances category is challenging in the sense that it is difficult to find indicators that would be robustly informative beyond the credit-to-GDP gap. We recommend current account to GDP ratio or its differences, which are the best indicators that we could find for this category. Our analysis with different prediction horizons indicates that it is more of a short-term indicator in line with Laeven & Valencia (2008), who find that in most banking crises there has been a current account deficit on the year preceding the crisis.

Among measures of potential mispricing of risk, the high-yield spread in the euro denominated corporate bond markets and VIX index were the most informative. Interestingly they are also robust against excluding the global financial crisis and the preceding period 2004Q1 onwards from the sample.⁵ In addition to these risk measures of international securities markets, authorities may wish to consider other indicators for risk pricing in the national securities market or at the banks, such as

⁴We did not have data on commercial real-estate prices but based on earlier literature (e.g. Bunda and Ca'Zorzi, 2010; Barrell et al. 2011; Kemme and Roy, 2012; Detken et al. 2014) they are also informative and worth monitoring if possible.

⁵Also the recommended indicators in previous four categories are robust against the exclusion of global financial crisis.

stock market based indicators or banks' household or corporate lending margin that were found to be somewhat informative.

Finally, in the measures of strength of bank balance sheets category the data series are shorter and we find only relatively weaker evidence in support of a number of indicators as we cross-check the results against different crisis datasets. These include the leverage ratio, loans to deposits ratio, total assets to GDP ratio and cross-border-loans to GDP ratio or their transformations. The results are most robust for the leverage ratio, and we recommend it to be used optionally supported with the above or other plausible indicators.

Also, many of the indicators perform consistently better (or worse) with the alternative crisis datasets, which indicates that the adjustments made to the dataset by Detken et al. (2014) in order to facilitate the policy objectives of the CCB, affect the performance of indicators.

Our work complements the existing literature (to be reviewed in the next section) which also tries to find indicators that could be used in a decision making when setting the CCB. However, compared to the previous literature, our work is more carefully focused on finding an indicator for each of the six categories in the ESRB recommendation. Castro et al. (2014) also categorize indicators based on the ESRB recommendation, but they leave the two categories measuring bank balance sheet strength and risk mispricing for later work, whereas we consider indicators for all the six categories. To our best knowledge, the findings for the informativeness of VIX index and high-yield corporate bond spread are new in the context of banking crisis literature, and highlight the importance of the global linkages in the financial system.

Our empirical analysis is also more comprehensive than that in the previous literature as we consider a larger assortment of potential indicators than any other study. We also use the data on EU countries instead of only one or few countries as is done in some of the studies. We also perform robustness analysis with different crisis variables and crisis prediction horizon, which is done only by Behn et al. (2013). Moreover, we evaluate the performance of the indicators both with a univariate as well as bivariate approach together with the credit-to-GDP gap. We prefer indicators which show forecasting power also when evaluated together with

the credit-to-GDP gap, which justifies their selection as additional indicators better than pure univariate forecasting performance.

The paper continues as follows. Section 2 discusses the literature and presents the potential indicators to be considered in each of the categories proposed by the ESRB. The empirical analysis and the data are described in Section 3, and Section 4 presents the empirical results. Section 5 discusses various frameworks on how the indicators should be interpreted by using thresholds and other relevant information. Section 6 concludes.

2 Early warning indicators identified in the previous literature

In this section we go through the content of the ESRB recommendation on operationalizing the countercyclical capital buffer and the recent literature that have a similar goal as we do: finding the indicators to be used in setting the CCB. We then list, based on empirical evidence presented in the literature or conceptual relevance, for each of the category the potential indicators to be analyzed in the empirical part of this work.

2.1 Operationalizing the countercyclical capital buffer

According to the recommendation by the European Systemic Risk Board (ESRB, 2014), the decision on setting the countercyclical capital buffer should primarily be based on deviation of the private sector credit to GDP ratio from its long term trend (credit-to-GDP gap), which has been confirmed by several empirical studies to be the best single indicator to predict banking crisis.⁶ However, as there always exists uncertainties for the signals given by EWIs, ESRB recommends that the authorities should base their decision on wider set of information that describes the vulnerabilities caused by excessive credit growth.⁷

ESRB has defined six categories of phenomena that are usually associated with

⁶See, e.g. Drehmann et al. (2010, 2011), Babecky et al. (2012), Behn et al. (2013), Bonfim and Monteiro (2013), Detken et al. (2014), Drehmann and Juselius (2014).

⁷For the criticism on credit-to-GDP gap, see e.g. Repullo and Saurina (2011).

the risks stemming from excessive credit growth.⁸ ESRB recommends that the authorities monitor and make publicly available at least one indicator for each of the categories in addition to the credit-to-GDP gap when setting the level of the CCB. The categories are the following: measures of credit developments, measures of private sector debt burden, measures of potential overvaluation of property prices, measures of external imbalances, measures of potential mispricing of risk, measures of the strength of bank balance sheets. As regards to actual indicators that could describe these six phenomena, ESRB gives some suggestions that are based on an empirical analysis by Detken et al. (2014), but does not provide specific recommendations. Hence, the decision on which indicators to choose is left for the national authorities.

The literature⁹ on EWIs for banking crisis is voluminous, but there are also few more recent studies that focus specifically on finding indicators that could be used in guiding decisions on the CCB. Besides Detken et al. (2014), Behn et al. (2013) evaluate a wide set of macro-financial and banking sector indicators using data for EU member states. They suggest that in addition to domestic factors, such as credit developments, equity and house prices, also global variables on house prices and credit developments seem to display good forecasting properties.¹⁰ More importantly, their results based on a multivariate approach suggest an improvement in crisis prediction compared to the univariate approach, which means that policy makers could indeed benefit from using a wider range of indicators when making the decision on the CCB.

Following Behn et al. (2013), Anundsen et al. (2014) also propose a set of multivariate early warning models that can guide policy makers when making a decision on the level of the CCB. They find that indicators on household (HH) credit developments predict crisis better than those of non-financial corporations

⁸There is also a seventh category of indicators included in the ESRB recommendation. This includes indicators that combine information on the credit-to-GDP gap and the indicators of the six other categories. At this point we do not consider the indicators for the seventh category in our empirical analysis, as the selection of the indicators in the seventh category should be made after finding the best indicators for the other six categories. Also, ESRB recommendation for the seventh category differs from the other categories as it does not include an advice for publishing the indicators of the seventh category.

⁹A comprehensive literature survey on the early warning indicators is provided by Kauko (2014).

¹⁰They remind that the success of these variables might at least partly be explained by the global financial crisis that causes a strong clustering of crisis episodes in the data.

(NFC) and that global housing market imbalances can be useful in signaling crisis. They also propose a novel measure of housing and credit market exuberance that is based on time-series methods proposed by Phillips et al. (2013). Bonfim and Monteiro (2013) also aim to find suitable indicators for implementation of the CCB. Their empirical analysis on nine European countries suggests that indicators on house and stock prices and credit developments deserve careful monitoring by the policy maker.

Castro et al. (2014) analyze a group of potential additional indicators with the Spanish data. They propose a new credit related measure that they call a ‘credit intensity’ (annual change in non-financial private-sector debt divided by four-quarter cumulated GDP), which they find useful in predicting banking crisis. They also confirm that indicators on real estate property prices, external imbalances and private sector debt sustainability are helpful when making decisions on the CCB. Giese et al. (2014) focus in their analysis on the UK, and suggest some complementary indicators to be used alongside with the credit-to-GDP gap. According to their results, sectoral credit developments and house price indicators give important information for the decision maker. The authors also find some bank balance sheet indicators such as leverage ratio and loans to deposits ratio important in explaining how credit boom is funded.

2.2 Candidate indicators for different categories

In the following subsections we propose candidate indicators for each of the six categories in the ESRB recommendation. On top of the indicators mentioned here, we consider various transformations such as growth rates, trend gaps, mean gaps etc. for each of the indicators. This is because the indicator as such might be nonstationary, which is not desirable for a good indicator. As Kauko et al. (2014) argue, if indicator does not have an equilibrium level that it tends to return, it is very hard to interpret the indicator, i.e. determine when the value of the indicator is exceptionally low or high. Using the transformations solves the potential problems of nonstationarity.

2.2.1 Measures of credit developments

The indicator measuring credit developments that has been analyzed perhaps the most is the credit growth. It has been found to be a statistically significant predictor of banking crisis in various studies (von Hagen and Ho, 2007; Barrell et al., 2010; Repullo and Saurina, 2011; Jordà et al., 2011; Bordo and Meissner, 2012; Schularick and Taylor, 2012; Behn et al., 2013; Drehmann and Juselius, 2014; Detken et al., 2014; Bonfim and Monteiro 2013). However, there are many alternative ways that one can measure credit growth and they all can be considered as potential indicators. One can e.g. consider different credit definitions, i.e. whether to define credit as a total credit that incorporates all credit regardless of the creditor or just the credit provided by the banks. One can also consider longer term growth rates such as 3-year-growth or absolute changes in credit levels instead of yearly growth rates. Moreover, one can analyze whether the growth of the credit for private sector, households or non-financial corporations have different kind of signaling power over banking crisis. For example, Büyükkarabacak and Valev (2010), Anundsen et al. (2014) and Detken et al. (2014) all find that indicators of household credit developments are better in predicting banking crisis compared to indicators of non-financial corporations.

There are also various indicators that one can consider that are close to the main indicator (credit-to-GDP gap), but yet contain other relevant information that might help predicting crisis. One can e.g. analyze the credit-to-GDP gap separately for households and non-financial corporations. These indicators can also be seen complementary to the credit-to-GDP gap, as they give more detailed information on what is underlying the signals in the primary indicator.

One of the weaknesses of the credit-to-GDP gap is that it tends to increase at times when GDP decreases (Repullo and Saurina, 2011). Even though it might not be desirable that the credit growth continues at the same speed even though the real economy slows down, it might be a bad idea to set the excess buffers for the banks in those circumstances. Especially if the credit growth has already stopped or weakened, increasing the capital requirements and slowing down the credit growth might cause an excessive negative shock for the economy. Kauko (2012a) proposes another measure for credit developments, where he divides the credit change with a

five-year moving average of the GDP. Kauko (2012a) argues that using the five-year moving average of the GDP instead of a yearly GDP addresses the problem of large short-term drops of the GDP affecting the value of the indicator in an unwanted way. Detken et al. (2014) confirm that the indicator in which the credit change is divided by the one-year moving average of the GDP forecasts systemic financial crisis better than any other indicator describing credit developments.

For measuring credit developments, we consider transformations of the following indicators: total real credit (private sector, HH, NFC), bank real credit (private sector), total credit / GDP (HH, NFC), bank credit / GDP (private sector).

2.2.2 Measures of private sector debt burden

Private sector indebtedness typically turns out to be at unsustainable level when the borrowers are not able to cope with their debt services any longer. High private sector debt burden can cause damage to the banks through credit risks, but also directly to the economy due to decreased consumption and investment. Hence, indicators describing the debt burden, i.e. debt-to-income ratio and debt service ratio¹¹ (DSR), might be valuable predictors of banking crisis. Both of these have indeed found to be useful in signaling crisis in many studies (e.g. Büyükkarabacak and Valev, 2010; Drehmann and Juselius, 2014; Detken et al., 2014; Giese et al, 2014). Just as in the case of the indicators on credit developments, it seems that adverse developments in the household debt burden are a bigger issue for financial stability compared to that of non-financial corporations, as both Büyükkarabacak and Valev (2010) and Detken et al. (2014) find that non-financial corporations' debt service ratio' has no predictive power for banking crisis.

The data on DSR are typically not available from public data sources. We were able to use the data sets collected for the studies in Drehmann and Juselius (2014) and Detken et al. (2014), but also considered 'proxies' for the DSR that are computed using public data sources. This proxy indicator covers only the estimated interest rate expenses of the households and does not take into account the amortization costs at all. We build an indicator of interest rate costs to GDP ratio (interest expense burden) by multiplying the household credit to GDP ratio by 3

¹¹Debt service ratio measures the interest rate and amortization costs of the debt relative to income.

month money market rate. Alternatively, we compute the same by using 10 year government bond yield as a proxy for fixed interest rates.

For measuring private sector debt burden, we consider transformations of the following indicators: household credit / personal disposable income, debt service ratio for private sector, households and non-financial corporations, household interest expense burden proxied with 3 month and 10 year interest rates.

2.2.3 Measures of potential overvaluation of property prices

Besides the indicators on the credit developments, variables related to developments in the real estate sector have often been found useful in predicting banking crisis (e.g. Drehmann et al., 2010, 2011; Behn et al., 2013; Drehmann and Juselius, 2014; Detken et al., 2014). In fact, it is found to be the combination of strong credit and house price growth that is particularly dangerous for the financial stability (Borio and Drehmann, 2009; Barrell et al., 2011; and Behn et al., 2013).

Credit and house prices tend to move hand-in-hand because the house purchases are typically financed with loans and the value of the house affects the decision to grant a loan through collateral process. On the other hand, as the mortgages form typically very significant share both in the households' and banks' balance sheets, both of them are vulnerable to large changes in housing prices. Mortgages might cause credit losses for banks, but they can also cause damage through other channels. Increasing house prices may lead to a construction boom, and hence crashing house prices would lead to reduced output and increase banks' loan losses from corporate loans as the construction business loses profitability. Moreover, banks typically use mortgages to secure their own market-based funding, so a sharp negative correction in house prices might increase the costs of funding for the banks. Hence, while credit and house price bubbles typically amplify each other, they also form a serious vulnerability for the banking sector due to their important role in the banks' business models.

Besides the house price growth, indicators that measure overvaluation in the real estate market have been found to be good predictors for banking crisis according to many studies (e.g. Bunda and Ca'Zorzi, 2010; Barrell et al. 2011; Roy and Kemme, 2012). Detken et al. (2014) find that these indicators perform better in

crisis prediction than for example any market or real economy based indicators. Unfortunately, it is difficult to get data on commercial real estate prices so we concentrate on the residential real estate. The state of the housing market can be assessed by comparing housing prices with household income or housing rents. Relative developments in housing prices and income reflect how affordable housing prices are from the buyers' point of view, whereas the relationship between housing prices and rents is conceptually identical with stock market price-to-earnings ratio.

For measuring potential overvaluation of property prices, we consider transformations of the following indicators: Real residential property price index, residential property price / rent and residential property price / income.

2.2.4 Measures of external imbalances

Besides the direct measures of credit developments, also the indicators that measure excessive credit growth indirectly have been found useful in predicting banking crisis. It is well known that when credit growth is much faster than that of GDP, domestic savings are typically not enough to finance the credit expansion and the indebtedness is then often financed by foreign money. As a result, the excessive foreign lending shows as a deficit in the current account. Many studies have found a link between large external imbalances and the frequency of financial crises. For example, Laeven and Valencia (2008) found that out of 41 banking crisis around the world, 39 countries had a current account deficit on the year preceding the crisis. There are also several other studies that find a statistically significant relationship between the current account deficit and the likelihood of the banking crisis (Kaminsky and Reinhart, 1999; Jordà et al., 2011; Roy and Kemme 2012; Bordo and Meissner, 2012; Kauko, 2012b; Lo Duca and Peltonen, 2013; Detken et al., 2014). However, if the sample consists only of emerging countries, the evidence on the link between the current account deficit and the banking crisis is not as strong (Domac and Martinez Peria, 2003; Joyce, 2011). Taylor (2013) argues that measures of external imbalances such as current account deficit might work as EWI for external crisis, but not for all kinds of crisis, which might explain the somewhat mixed results for this indicator.

It has been argued in the literature that foreign money, especially portfolio in-

vestments, is a more unstable source of credit compared to domestic credit and hence a large share of foreign money might create a vulnerability to the financial system. This might be explained by the fact that foreign investors' ability to evaluate the risks in the country is worse than that of domestic investors (Kauko 2012a). For this same reason it has been argued that herding behavior is more typical for foreign investors, which might increase the accumulation of the external imbalances as well as a fast pull-out in case risks materialize. Hence, we consider also capital account deficits as an indicator for external imbalances. We also include separate indicators for portfolio investments and other investments, which are considered to be short-and hence be the most volatile items of all foreign investments.

For measuring external imbalances, we consider the following indicators: current account / GDP, capital account / GDP, portfolio investments / GDP, other investments / GDP.

2.2.5 Measures of potential mispricing of risk

Credit and asset price bubbles are typically associated with times of positive economic developments. During long periods of good times, agents' perception of the risks tends to decrease, which might lead to loosening of the credit standards set by banks or to lower risk premia in the risky securities demanded by the investors. It is very difficult if not possible to measure risk perceptions or determine when the risks are mispriced, but one could try to do it by using measures on credit standards or risk premia on different assets.

Potential indicators for risk mispricing in the banks could be e.g. the changes in the interest rate margin that banks require for the loans they grant for households and corporations. A fast decrease in margins on new bank loans might indicate that banks are mispricing risk e.g. due to increased competition. In the securities markets, one could look on the developments in the stock and bond markets. Fast price increases on the stock market and high stock valuations (e.g. share prices relative to dividend yields, i.e. P/E ratios) as well as a rapid decrease in the required risk premia between safe and risky corporate bonds might reflect increase in investors' risk appetite that might lead to mispricing of risk. Also, low levels of asset return volatility typically lead to increased risk taking due to the fact that at times of low

volatility one needs to invest to riskier assets in order to get the same returns as at times of higher volatility. Some tools used in the banks' risk management, such as Value-at-Risk metric also tend to allow higher risk taking at times of low volatility which might then lead to excess risk taking in the banks.

The results of the previous literature on equity market indicators are mixed. Drehmann et al. (2011) and Behn et al. (2013) find the link between stock market developments and banking crisis, but Schularick and Taylor (2012) do not. One potential problem related to the measures of risk premia in the corporate bond market is that it is difficult to find country-specific data for these indicators. Hence, we need to use the same indicator of euro denominated bonds on all the countries in the data set. On the other hand, mispricing of risk might be dangerous phenomenon especially if it happens among the international investors. There are a few studies that suggest that global indicators, such as global equity price growth (Behn et al., 2013) and global liquidity measures and global credit-to-GDP gap (Alessi and Detken, 2011) might also be useful in predicting local crisis, which motivates the use of some global or international variables in crisis prediction.

For measuring potential mispricing of risk, we consider the following indicators: lending margin of household loans, lending margin of corporate loans, stock and bank stock price index, stock index volatility, dividend yield, P/E ratio, P/B ratio, CBOE volatility index (VIX), high-yield corporate bond risk premia, long and short-term interest rates of two major economies (USA and Germany).

2.2.6 Measures of the strength of bank balance sheet

Although it is quite clear that the causes of the banking crisis are likely to be at least partly explained by the vulnerabilities in the banks' balance sheets, finding EWIs from banks' balance sheets is not easy. This is probably due to data issues, as the data on banks' aggregate balance sheets tends to be short and published mostly on a yearly basis, as well as contain structural breaks due to changes in the banking industry and accounting standards.

Detken et al. (2014) consider leverage ratio as an EWI for a systemic banking crisis, but do not find any predictive power for this indicator. Behn et al. (2013) find that higher aggregate banking sector capitalization decreases the probability

of banking crisis while higher banking sector profits may incur excessive risk-taking and tend to precede banking crisis.

There are also some empirical evidence that the indicators of the banks' funding structure might work as an EWI for banking crisis. Banks' funding can be divided into 'core liabilities' (stable deposits) and non-core liabilities (e.g. unstable short-term wholesale funding). At times of the rapid lending growth, banks might finance the increased lending with market funding, because the developments in the deposit funding tend to be more stable. While in the good times the market funding might be cheap and easily available, in the bad times the cost of market funding tends to increase faster than that of deposits, or disappear altogether in the worst place. Hence, a higher share of more 'unstable' market funding makes banks vulnerable to the shocks in the international financial market. Kamin and DeMarco (2012) and Lainà et al. (2015) have found evidence that larger share of the deposit funding has a stabilizing effect for the financial system, whereas Hahm et al. (2013) and Betz et al. (2013) show that a high share of the so-called non-core liabilities is a good predictor of a banking crisis.

For measuring the strength of the bank balance sheet, we consider transformations of the following indicators: total assets / GDP, leverage ratio, loans / deposits, non-core liabilities / total assets or GDP, (short-term liabilities - liquid assets) / total assets, short-term liabilities / liquid assets, cross-border loans / GDP, cross-border loans / total assets.

3 Empirical analysis

3.1 Data

3.1.1 Banking crisis datasets

Various banking crisis datasets that report the banking crises in a large number of countries have been made available by the earlier literature. The dataset compiled by Babecky et al. (2012) as part of a data collection exercise by the European System of Central Banks (ESCB) Heads of Research Group (HoR) contains quarterly information on banking crises in EU countries between 1970Q1 and 2012Q4.

Detken et al. (2014) take HoR as a starting point but make a number of modifications to the database in order to align it with the objectives and operation of the CCB. Crises that were not systemic banking crises or not associated with a domestic credit/financial cycle were excluded and periods where domestic developments related to the credit/financial cycle could well have caused a systemic banking crisis, had it not been for policy action or an external event that dampened the financial cycle were added. Because we build on the work of Detken et al. (2014), it is natural to use the same crisis dataset. However, in light of the fact that there are significant differences between the various banking crisis datasets and divergent opinions on which events should be included as a banking crisis in this type of a study, we also calculate and include in the Annex B the results obtained when using HoR dataset or yet another banking crisis dataset provided by Laeven and Valencia (2012) (LV). The definitions of banking crises and banking crises events for each country are summarized in Annex A Tables A1-A2.

3.1.2 Indicator data

The quarterly indicator data aims to cover 28 EU member states for the period from 1970Q1 to 2012Q4 on a best effort basis. Admittedly for many of the Eastern European countries and some specific indicators it was not possible to find long time series, the situation being particularly difficult for banks' balance sheet data. The data sources are summarized as follows: Credit aggregates (BIS), credit interest spreads and bank balance sheet data (ECB), house price indicators (OECD), stock index and dividend yields (Bloomberg), disposable income (FED). In addition, we received from BIS the data on debt service ratio that was used in Drehmann and Juselius (2014), and from ESRB the data on debt service ratio for households and corporates that were used in Detken et al. (2014).

3.1.3 Indicator transformations

When it is reasonable¹², we consider following transformations of the indicator data: 1 year growth, 3 year growth, 1 year difference, 3 year difference, trend gap (devi-

¹²For example for a panel of house price indices only relative changes and relative trend deviations make sense in the panel setting. Also for some of the shorter data series, we omit the trend deviation transformations.

ation from a long-term trend calculated with the one-sided Hodrick–Prescott filter and smoothing parameter $\lambda = 400,000$), relative gap (time series divided by its trend, which is calculated similarly as in the previous transformation), deviation from 5 year moving average (denoted 5 year m.a. gap), recursively calculated deviation from mean (denoted m.a. gap). To ensure robustness of the gaps, we require 5 years of prior data. For the credit-to-GDP ratios with different credit aggregates, we consider the additional transformation whereby 1 year change of the credit aggregate is divided by the 5 year moving average of GDP, which is more stable than the trend gap in the event of abruptly decreasing GDP. Detailed formulas for the transformations are included in Annex B.

3.2 Evaluation methodology

3.2.1 Pre-crisis dummy

We aim to identify the indicators that best signal vulnerabilities that may lead to a systemic banking crisis based on the evolution of the indicator values during tranquil times and during a pre-crisis horizon prior to the banking crisis. By assumption the system is in a vulnerable state during the pre-crisis quarters 12 to 4 quarters before the crisis. In addition to tranquil quarters and pre-crisis quarters, there are the late pre-crisis quarters and crisis quarters. We define a pre-crisis dummy, which is 0 for the tranquil quarters, 1 for the pre-crisis quarters, and undefined for the late pre-crisis quarters and crisis quarters.¹³ Additionally, the pre-crisis dummy is not defined from 2010Q1 onwards as the state is not yet known. Table A3 in Annex A illustrates the tranquil, pre-crisis, crisis, and other excluded quarters for the Detken et al. (2014) crisis dataset. As we do not perform any analysis involving threshold optimization, it is enough to account for the publication lags implicitly with the understanding that e.g. a signal based on indicator values 12 quarters prior to the crisis would actually have been observed 1-2 quarters later.

As a robustness check, we follow the approach in Drehmann and Juselius (2014)

¹³Also the post-crisis quarters that take place e.g. 4 quarters after the last crisis quarter can be left out. We follow Detken et al. (2014) who do not distinguish between crisis and post-crisis quarters and assume that the post-crisis/recovery quarters are sufficiently included in the crisis quarters. Ultimately the need to correct for the post-crisis bias depends on how the specific crisis dataset is defined.

and calculate in Annex C results for indicators using different horizons. In that case the pre-crisis dummy is defined as previously, except that the dummy equals 1 for a single quarter n quarters prior to the crisis, where $n = 1, 2, \dots, 20$, while the dummy is undefined for the other pre-crisis quarters. Following the approach of Drehmann and Juselius (2014), only those crisis events are included for which pre-crisis data is available for 20 quarters prior to the crisis. Table A4 in Annex A illustrates the pre-crisis dummy in such case.

3.2.2 Evaluation of indicator performance

In evaluating the performance of EWIs we follow the signaling approach, in which the indicator signals vulnerable state in case it is above a given threshold (or below, if small rather than large values of the indicator indicate vulnerability). Receiver operating characteristic (ROC) is the mapping that specifies the trade-off between false alarms (false positives) and missed crises (false negatives) for all possible threshold values of the EWI. Specifically, $ROC = TP(FP)$, where TP is the true positive rate (fraction of sample's pre-crisis quarters for which the EWI signaled a crisis) and FP is the false positive rate (fraction of sample's tranquil periods for which the EWI signaled a false alarm). The area under the ROC curve, $AUC = \int_0^1 TP(FP)dFP$, is a natural non-parametric measure for indicators ability to distinguish between pre-crisis and tranquil periods. For a perfectly uninformative indicator $TP = FP$, and hence $AUC = 0.5$. As a rule of thumb, the more the AUC differs from 0.5, the better the indicator. If large values of indicator indicate vulnerability $AUC > 0.5$, if small values indicate vulnerability $AUC < 0.5$. As there is uncertainty involved in estimating AUC , we also report the cluster bootstrapped standard errors and statistical significance of the deviation of AUC from 0.5. In discussing the results we refer to indicators with statistically significant $AUC > 0.8$ or $AUC < 0.2$ as strong, with $0.7 < AUC < 0.8$ or $0.2 < AUC < 0.3$ as quite strong, with $0.65 < AUC < 0.7$ or $0.3 < AUC < 0.35$ as quite weak, and with $0.35 < AUC < 0.65$ but statistically significantly different from 0.5 as weak, and as uninformative otherwise.

The best indicators are selected based on the AUC and three other criteria. First, in a univariate logistic model that aims to explain the probability to be in a vulnerable state based on the value of indicator alone, the coefficient of the indicator

should be statistically significantly different from zero. Second, the coefficient should remain statistically significant if credit-to-GDP is included as a control variable. Third, the interpretation of the indicator needs to be sensible and robust against small adjustments in the definition pre-crisis horizon and robust against the use of the alternative crisis datasets.

4 Results of the empirical analysis

In this section we go through the results for each indicator category in the ESRB recommendation. In each case, a table of shortlisted indicators is shown that reports the indicators that are statistically significant both alone and in the joint evaluation with the credit-to-GDP gap. The discussion is structured such that within each category we first report the results with the crisis dataset of Detken et al. (2014) and subsequently comment on the robustness of results against alternative crisis datasets and against different horizons. Only the results for shortlisted indicators obtained with the Detken et al. (2014) banking crisis dataset are shown here. The full set of results for all indicators and transformations as well as the results with the ESCB Heads of Research (HoR) and Laeven and Valencia (LV) datasets are available in Annex B. The results for different horizons for the shortlisted indicators are available in Annex C.

4.1 Measures of credit developments

Table 1. Measures of credit developments. See Annex B for full table.

Indicator	Transformation	univariate			Indicator			Indicator			Credit-to-GDP gap				
		AUC		Logit coeff.	Cr	Co	N	Logit coeff.		Logit coeff.	Cr	Co	N		
Credit-to-GDP gap	trend gap	0.83***	(0.03)	9.875***	(1.657)	20	18	1803							
HH credit (real)	3y growth	0.71***	(0.05)	0.016***	(0.005)	12	15	884	6.6e-03*	(3.6e-03)	7.815***	(1.057)	12	15	873
	relative gap	0.69**	(0.07)	0.044***	(0.016)	12	15	810	0.030**	(0.015)	7.310***	(1.151)	12	15	810
Bank credit / GDP	3y difference	0.84***	(0.04)	10.687***	(2.615)	21	18	1884	6.657**	(3.326)	4.480*	(2.621)	20	18	1785
	trend gap	0.83***	(0.03)	12.800***	(2.724)	20	18	1771	7.492*	(4.530)	4.756	(3.220)	20	18	1771
(1y diff. in bank credit) / 5y m.a. GDP		0.80***	(0.05)	19.686***	(5.559)	22	18	2040	14.634*	(7.671)	4.301**	(1.915)	20	18	1799
HH credit / GDP	3y difference	0.85***	(0.03)	20.652***	(2.497)	18	18	1255	19.135***	(4.442)	1.093	(2.743)	18	18	1226
	1y difference	0.79***	(0.04)	39.528***	(5.554)	20	18	1385	26.071**	(11.659)	5.165**	(2.095)	18	18	1299
	trend gap	0.83***	(0.03)	25.078***	(5.306)	18	18	1150	15.470**	(7.005)	5.442**	(2.192)	18	18	1150
(1y diff. in HH credit) / 5y m.a. GDP		0.80***	(0.04)	35.140***	(6.487)	20	18	1389	29.554***	(10.341)	3.976**	(1.858)	18	18	1299
NFC credit / GDP	trend gap	0.68***	(0.05)	8.066***	(3.024)	18	18	1131	-24.712***	(5.174)	23.896***	(3.599)	18	18	1131

Robust standard errors adjusted for clustering are reported in the parentheses. **, * and *** indicate statistical significance at the 10 %, 5 % and 1 %-level.

Evaluation horizon is 1 to 3 years. CCB group's crisis dataset is used. Statistical significance and larger |AUC-0.5| indicates better performance.

Cr is the number of crises, Co is the number of countries, N is the number of observations.

Credit refers to all credit regardless of the creditor whereas bank credit contains only the credit provided by banks.

If not otherwise mentioned, credit includes non-financial corporate (NFC) and household (HH) credit.

The strongest indicators in this category are 3 year differences and trend gap in the ratio of household credit to GDP and in the ratio of bank credit to GDP. These indicators have strong indicative power similar to the primary indicator credit-to-GDP gap. Regarding shorter term credit developments, the ratio of the 1 year change in household or bank credit to moving average GDP performs also well as does the 1 year difference in the household or bank credit to GDP ratio. We also note that transformations of corporate credit to GDP or real corporate credit typically have a statistically significant negative sign in joint evaluation with the credit-to-GDP gap, which points toward its complement in the total credit, i.e. household credit, as the primary driver of banking crises. Among the indicators that describe real credit developments, only the 3 year difference and relative gap of real household credit (i.e. 3y growth and relative gap) have indicative power beyond credit-to-GDP gap.

The results are qualitatively robust against changing the crisis dataset. However, credit-to-GDP measures perform slightly stronger with the LV dataset and weaker with the HoR crisis dataset. Also all of the real credit development indicators, including those for households, perform weaker for both alternative datasets. Apart from corporate credit to GDP gap, which has indicative power only in the short-term, the shortlisted indicators have steady indicative power across wide set of horizons (Annex C, Table C1.A).

4.2 Measures of private sector debt burden

In line with the success of household debt to GDP developments in the preceding indicator category, changes in the household credit to gross disposable income (GDI) are among the top indicators in this category. In addition, most transformations of the debt service ratio and the proxy for household interest expenses that included the 3 month interest rate have quite high indicative power and contain information on vulnerability beyond the credit-to-GDP gap. The corresponding proxy for interest expenses with 10 year interest rate is less informative.

The results are qualitatively robust against changing the crisis dataset while quantitatively a little stronger with the LV dataset and a little weaker with the HoR dataset. Apart from the first indicator (HH debt to GDI), the shortlisted indicators have weak indicative power beyond three year horizon (Annex C, Table C1.B).

Table 2. Measures of private sector debt burden. See Annex B for full table.

Indicator	Transformation	univariate			Indicator			Indicator			Credit-to-GDP gap				
		AUC	Logit coeff.		Cr	Co	N	Logit coeff.	Logit coeff.		Cr	Co	N		
HH credit / GDI	3y difference	0.79***	(0.05)	2.6e-03***	(3.0e-04)	15	11	975	2.5e-03***	(4.4e-04)	9.371***	(1.462)	15	11	975
	1y difference	0.78***	(0.04)	6.5e-03***	(8.0e-04)	15	11	1055	6.3e-03***	(1.2e-03)	9.403***	(1.353)	15	11	1055
	trend gap	0.82***	(0.04)	4.5e-03***	(4.6e-04)	15	11	905	4.1e-03***	(7.3e-04)	8.828***	(1.509)	15	11	905
HH DSR (BIS)	1y growth	0.71***	(0.04)	0.104***	(0.025)	16	12	1289	0.069***	(0.022)	8.572***	(1.950)	16	12	1259
	1y difference	0.73***	(0.04)	0.573***	(0.217)	16	12	1289	0.329**	(0.148)	8.306***	(1.882)	16	12	1259
DSR (ESRB)	3y growth	0.74***	(0.03)	0.020***	(0.006)	23	25	1989	0.029***	(0.010)	7.560***	(1.935)	19	17	1476
	1y growth	0.75***	(0.02)	0.049**	(0.022)	25	26	2185	0.075***	(0.026)	7.889***	(1.768)	19	17	1516
	3y difference	0.77***	(0.03)	23.761**	(10.510)	23	25	1989	11.411**	(5.208)	7.859***	(1.868)	19	17	1476
	1y difference	0.79***	(0.02)	54.819***	(15.797)	25	26	2185	40.935***	(11.498)	7.604***	(1.768)	19	17	1516
	trend gap	0.73***	(0.04)	35.962***	(10.662)	21	22	1837	13.601**	(6.615)	6.953***	(1.940)	18	16	1441
NFC DSR (ESRB)	1y growth	0.74***	(0.04)	0.073***	(0.022)	17	25	990	0.048**	(0.021)	6.833***	(1.176)	13	16	844
HH DSR (ESRB)	3y difference	0.77***	(0.06)	49.391***	(12.542)	15	23	795	45.760**	(18.022)	4.449*	(2.286)	13	16	735
	1y difference	0.73***	(0.04)	76.289***	(20.140)	18	25	976	73.448***	(24.632)	6.053***	(1.486)	14	16	830
HH credit * 10y bond rate / GDP															
	1y difference	0.63***	(0.04)	1.030***	(0.321)	16	18	907	0.715**	(0.363)	8.134***	(1.370)	16	17	902
HH credit * 3m money market rate / GDP		0.63**	(0.05)	0.309**	(0.124)	20	25	1350	0.465***	(0.141)	9.920***	(1.513)	17	17	1123
	3y growth	0.72***	(0.04)	6.2e-03***	(2.0e-03)	19	25	1087	7.1e-03**	(2.8e-03)	8.120***	(1.656)	17	17	969
	1y growth	0.73***	(0.03)	0.019***	(0.005)	20	25	1262	0.022***	(0.005)	8.658***	(1.576)	17	17	1073
	3y difference	0.74***	(0.04)	0.814***	(0.224)	19	25	1087	0.859***	(0.239)	7.658***	(1.790)	17	17	969
	1y difference	0.73***	(0.04)	1.234***	(0.383)	20	25	1262	1.416***	(0.244)	8.623***	(1.714)	17	17	1073
	trend gap	0.71***	(0.06)	0.950***	(0.332)	18	25	928	0.782**	(0.333)	7.056***	(1.627)	16	17	863

Robust standard errors adjusted for clustering are reported in the parentheses. **, * and *** indicate statistical significance at the 10 %, 5 % and 1 %-level.

Evaluation horizon is 1 to 3 years. CCB group's crisis dataset is used. Statistical significance and larger |AUC-0.5| indicates better performance.

Cr is the number of crises, Co is the number of countries, N is the number of observations. GDI= Gross Disposable Income, DSR=Debt-Service-Ratio.

If not otherwise stated, credit includes non-financial corporate (NFC) and household (HH) credit.

4.3 Measures of potential overvaluation of property prices

Table 3. Measures of potential overvaluation of property prices. See Annex B for full table.

Indicator	Transformation	univariate			Indicator			Indicator			Credit-to-GDP gap				
		AUC	Logit coeff.		Cr	Co	N	Logit coeff.	Logit coeff.		Cr	Co	N		
Residential property price / income		0.75***	(0.05)	0.027**	(0.013)	22	21	1507	0.015*	(0.009)	7.587***	(1.512)	19	16	1370
	3y growth	0.75***	(0.05)	0.045***	(0.014)	20	18	1277	0.040**	(0.018)	7.191***	(0.764)	18	14	1196
	1y growth	0.64***	(0.05)	0.052***	(0.018)	21	20	1430	0.050*	(0.026)	8.431***	(1.075)	19	16	1317
	3y difference	0.76***	(0.05)	0.072***	(0.019)	20	18	1277	0.061**	(0.027)	6.388***	(0.812)	18	14	1196
	1y difference	0.65**	(0.05)	0.082***	(0.022)	21	20	1430	0.064**	(0.032)	8.192***	(1.014)	19	16	1317
	trend gap	0.78***	(0.05)	0.127***	(0.028)	19	18	1164	0.081**	(0.035)	6.535***	(1.216)	17	14	1111

Robust standard errors adjusted for clustering are reported in the parentheses. **, * and *** indicate statistical significance at the 10 %, 5 % and 1 %-level.

Evaluation horizon is 1 to 3 years. CCB group's crisis dataset is used. Statistical significance and larger |AUC-0.5| indicates better performance.

Cr is the number of crises, Co is the number of countries, N is the number of observations.

We find residential property price to income ratio and its various transformations to have quite high indicative power. These indicators outperform the corresponding real prices and price-to-rent ratios in the sense that the latter are not statistically significant in the joint evaluation with the credit-to-GDP gap.

The performance of all the property overvaluation indicators is very similar for all three datasets. The indicative power is strongest 2 to 3 years prior to the crisis but stronger than that for the debt burden indicators also at the longer horizons (Annex C, Table C1.C).

Table 4. Measures of external imbalances. See Annex B for full table.

Indicator	Transformation	univariate			Indicator			Indicator			Credit-to-GDP gap				
		AUC		Logit coeff.	Cr	Co	N	Logit coeff.		Logit coeff.	Cr	Co	N		
Current account / GDP		0.34***	(0.05)	-0.264***	(0.083)	22	26	1897	-0.199	(0.239)	9.149***	(1.689)	17	18	1305
	3y growth	0.56	(0.03)	-7.1e-07	(1.1e-05)	21	26	1613	4.0e-06	(1.2e-05)	9.287***	(1.438)	17	18	1179
	1y growth	0.60***	(0.03)	9.3e-06	(1.0e-05)	22	26	1804	1.3e-06	(9.2e-06)	9.549***	(1.422)	17	18	1271
	3y difference	0.34***	(0.04)	-0.352***	(0.122)	21	26	1614	-0.434	(0.306)	8.455***	(1.621)	17	18	1179
	1y difference	0.39***	(0.03)	-0.272**	(0.118)	22	26	1805	-0.516**	(0.219)	9.231***	(1.386)	17	18	1271

Robust standard errors adjusted for clustering are reported in the parentheses. *,** and *** indicate statistical significance at the 10 %, 5 % and 1 %-level.

Evaluation horizon is 1 to 3 years. CCB group's crisis dataset is used. Statistical significance and larger |AUC-0.5| indicates better performance.

Cr is the number of crises, Co is the number of countries, N is the number of observations.

4.4 Measures of external imbalances

All the external imbalance indicators have quite low if any indicative power within the Detken et al. crisis dataset. Initially we find that with quite low indicative power only the 1 year difference in the current account to GDP ratio is statistically significant both alone and in the joint evaluation with the credit-to-GDP gap. Taken alone, the level and 3 year difference in the current account to GDP ratio had the best indicative power yet they are not statistically significant with the credit-to-GDP gap.

The indicative power of the absolute changes in the current account to GDP ratio is robust against using the alternative crisis datasets, and while not statistically significant in the joint evaluation with the credit-to-GDP gap, the logit coefficient of the indicator has the right sign in all cases. These indicators perform better for short-horizons up to 2 years before the onset of crisis (Annex C, Table C1.D).

4.5 Measures of potential mispricing of risk

The level of high-yield spread in euro denominated corporate bond markets and VIX index and its various transformations have quite high indicative power and are statistically significant in the joint evaluation with the credit-to-GDP gap. In both cases the sign of the coefficient is negative, meaning that lower spread or lower volatility indicates increased risk of banking crisis. Also the country specific household and corporate lending margins have negative sign coefficients and some indicative power. However, the data series is quite short and the number of crises is below 10. Country specific stock market based indicators have some but generally not quite high indicative power. Increase in market index return or bank index return, and decrease in P/E ratio or dividend yield, while having quite weak indicative power, are

Table 5. Measures of potential mispricing of risk. See Annex B for full table.

Indicator	Transformation	univariate			Indicator			Indicator			Credit-to-GDP gap		
		AUC	Logit coeff.	Cr Co N	Logit coeff.	Cr Co N	Logit coeff.	Cr Co N	Logit coeff.	Cr Co N			
Stock market index	3y growth	0.67*** (0.04)	4.0e-03** (2.0e-03)	14 14 971	7.8e-03*** (2.6e-03)	10.028*** (1.661)	14 13 920						
Bank stock index	3y growth	0.62** (0.05)	3.5e-03* (2.1e-03)	16 13 1009	7.0e-03*** (2.5e-03)	8.834*** (1.271)	16 13 1009						
NFC lending margin	3y difference	0.31** (0.08)	-2.505*** (0.816)	10 19 187	-2.752*** (0.960)	7.785*** (2.561)	8 16 167						
High-yield corporate bond spread		0.20*** (0.04)	-4.3e-03*** (1.5e-03)	16 28 1066	-5.4e-03** (2.3e-03)	7.506*** (1.584)	12 18 623						
	3y growth	0.41*** (0.03)	-7.1e-03*** (2.0e-03)	14 28 770	-0.013*** (0.003)	7.726*** (1.613)	10 18 457						
	1y growth	0.45*** (0.02)	-4.4e-03*** (1.3e-03)	15 28 971	-5.1e-03*** (1.6e-03)	7.412*** (1.530)	11 18 573						
	3y difference	0.43*** (0.03)	-4.1e-04** (1.6e-04)	14 28 770	-8.3e-04*** (3.0e-04)	7.097*** (1.541)	10 18 457						
CBOE Volatility Index (VIX)		0.29*** (0.03)	-0.123*** (0.029)	29 28 2232	-0.116*** (0.028)	9.610*** (1.770)	18 18 1183						
	3y growth	0.32*** (0.05)	-0.013** (0.006)	27 28 1908	-0.015* (0.009)	8.140*** (1.361)	16 18 1027						
	3y difference	0.33*** (0.05)	-0.070*** (0.022)	27 28 1908	-0.085*** (0.031)	8.186*** (1.375)	16 18 1027						
	trend gap	0.31*** (0.05)	-0.108*** (0.034)	25 28 1737	-0.124*** (0.045)	7.495*** (1.278)	15 18 953						
German 1y bill	3y growth	0.59* (0.05)	5.8e-03** (2.7e-03)	30 28 2423	9.4e-03*** (2.6e-03)	8.700*** (1.328)	19 18 1276						
	1y growth	0.64** (0.05)	0.017*** (0.005)	30 28 2639	0.027*** (0.004)	9.255*** (1.489)	19 18 1380						
	1y difference	0.63** (0.05)	0.286** (0.125)	30 28 2639	0.627*** (0.107)	9.419*** (1.459)	19 18 1380						
German 1m bill	1y growth	0.60** (0.04)	6.0e-03** (2.8e-03)	30 28 3071	0.014*** (0.002)	10.325*** (1.571)	19 18 1588						
US 1y T-bill	3y growth	0.72*** (0.05)	8.0e-03*** (1.4e-03)	30 28 2423	8.9e-03*** (1.8e-03)	8.906*** (1.603)	19 18 1276						
	1y growth	0.61*** (0.03)	6.4e-03*** (2.2e-03)	30 28 2639	7.7e-03** (3.0e-03)	8.985*** (1.248)	19 18 1380						
	3y difference	0.71*** (0.05)	0.298*** (0.087)	30 28 2423	0.361*** (0.109)	9.189*** (1.681)	19 18 1276						
	1y difference	0.61*** (0.03)	0.209*** (0.060)	30 28 2639	0.309*** (0.116)	9.243*** (1.379)	19 18 1380						
	trend gap	0.67*** (0.05)	0.405** (0.166)	29 28 2232	0.745*** (0.255)	10.470*** (2.144)	18 18 1183						
US 1m T-bill	3y growth	0.71*** (0.05)	7.3e-03*** (1.2e-03)	30 28 2855	7.7e-03*** (1.6e-03)	9.361*** (1.778)	19 18 1484						
	1y growth	0.62*** (0.04)	7.9e-03*** (2.3e-03)	30 28 3071	9.4e-03*** (3.0e-03)	9.865*** (1.543)	19 18 1588						
	3y difference	0.68*** (0.05)	0.144*** (0.039)	30 28 2855	0.190*** (0.056)	9.846*** (1.634)	19 18 1484						
	1y difference	0.61*** (0.03)	0.093*** (0.028)	30 28 3071	0.170*** (0.054)	10.142*** (1.525)	19 18 1588						
	trend gap	0.72*** (0.04)	0.458*** (0.127)	30 28 2666	0.516*** (0.183)	8.880*** (1.536)	19 18 1393						

Robust standard errors adjusted for clustering are reported in the parentheses. **, * and *** indicate statistical significance at the 10 %, 5 % and 1 %-level.

Evaluation horizon is 1 to 3 years. CCB group's crisis dataset is used. Statistical significance and larger |AUC-0.5| indicates better performance.

Cr is the number of crises, Co is the number of countries, N is the number of observations.

statistically significant in the joint evaluation with credit-to-GDP gap. For these indicators the 3 year changes tend to be more informative than 1 year changes. Last, the category included US and German government bond yields. The level of the bond yields typically have some indicative power with negative coefficient but are mostly not statistically significant when evaluated jointly with the credit-to-GDP gap. This result is associated with the long-term trend of declining interest rates, which coincides with the long-term trend of debt accumulation and the long-term trend of increasing number of banking crises. The changes in the shorter term US Treasury bill rates have indicative power similar or better than the country specific stock market indicators. The sign of the logit coefficient is positive, which indicates that the increases in the shorter term US rates have historically preceded the banking crises in EU.

The results of indicators of potential mispricing of risk are generally robust and stronger with the alternative crisis datasets. Euro denominated corporate bond high-yield spread and VIX index and its various transformations become very strong indicators with the HoR and LV crisis datasets. Results for stock market based indicators become a little stronger but their indicative power remains quite weak. Results for corporate and household lending margins and for government bond yields

become a little stronger. The differences with respect to the Detken et al. crisis dataset are likely related to their adjustments of the crisis dataset to reflect the domestic credit cycle developments.

The high-yield corporate bond spread and VIX index have better indicative power in longer horizons 2 to 4 years prior to the crisis. In contrast, stock market variables perform at their best 1 to 2 years prior to the crisis and US/German short-term government yields 1 to 3 year prior to the crisis (Annex C, Table C1.E). The results for VIX index generally hold if the global financial crisis (and the preceding pre-crisis quarters) are excluded from the sample. The same is true for the high-yield corporate bond spread, however in the latter case the number of observations and crises becomes very low due to the shorter data series.

4.6 Measures of strength of bank balance sheets

Table 6. Measures of the strength of bank balance sheets. See Annex B for full table.

Indicator	Transformation	univariate	Indicator			Indicator	Credit-to-GDP gap				
		AUC	Logit coeff.		Cr Co N	Logit coeff.	Logit coeff.		Cr Co N		
Leverage ratio		0.38 (0.08)	-0.179 (0.124)	14	26	719	-0.170 (0.186)	6.197*** (1.568)	12	18	563
	3y growth	0.33** (0.08)	-0.044* (0.024)	12	25	444	-0.024 (0.022)	5.592*** (1.930)	10	18	380
	1y growth	0.41* (0.05)	-0.032 (0.023)	13	26	628	-7.6e-03 (2.4e-02)	6.405*** (1.679)	11	18	504
	3y difference	0.34** (0.07)	-0.380 (0.235)	12	25	444	-0.185 (0.236)	5.828*** (1.797)	10	18	380
	1y difference	0.41* (0.05)	-0.357 (0.220)	13	26	628	-0.086 (0.298)	6.426*** (1.634)	11	18	504
Loans / deposits		0.67* (0.07)	0.011*** (0.003)	12	26	537	7.0e-03 (4.9e-03)	5.903*** (1.437)	10	18	405
	1y growth	0.55 (0.07)	0.018 (0.030)	12	26	446	-0.034 (0.048)	7.009*** (1.594)	10	18	347
	1y difference	0.59 (0.07)	0.039 (0.027)	12	26	446	-7.7e-03 (3.8e-02)	6.845*** (1.651)	10	18	347
Total assets / GDP		0.56 (0.08)	-0.037 (0.041)	14	21	759	-0.047 (0.051)	7.210*** (1.437)	13	18	654
	3y growth	0.67** (0.07)	0.029** (0.012)	12	20	526	4.9e-03 (1.8e-02)	6.246*** (2.036)	11	18	489
	1y growth	0.69*** (0.05)	0.067*** (0.022)	13	21	678	0.027 (0.029)	6.327*** (1.552)	12	18	597
	3y difference	0.59 (0.08)	0.095 (0.280)	12	20	526	-0.197 (0.285)	7.063*** (1.966)	11	18	489
	1y difference	0.65*** (0.05)	0.240 (0.370)	13	21	678	-0.129 (0.373)	6.906*** (1.594)	12	18	597

Robust standard errors adjusted for clustering are reported in the parentheses. ** and *** indicate statistical significance at the 10 %, 5 % and 1 %-level.

Evaluation horizon is 1 to 3 years. CCB group's crisis dataset is used. Statistical significance and larger |AUC-0.5| indicates better performance.

Cr is the number of crises, Co is the number of countries, N is the number of observations.

While some of the indicators of strength of bank balance sheets perform reasonably well alone, none of the indicators is statistically significant in the joint evaluation with the credit-to-GDP gap when using the Detken et al. (2014) crisis dataset. Part of the difficulty arises from the short time series that are available, and another difficulty is related to the indicator category itself in the sense that the strength of bank balance sheet is difficult to measure until the losses materialize. For the HoR and LV crisis datasets the category performed notably better, and hence for this category we directly report the results that are most consistent across all the crisis datasets (see Annex B, Tables B2.F and B3.F).

The level of leverage ratio has a quite weak indicative power but it is statistically highly significant with the alternative crisis datasets, also in the joint evaluation with the credit-to-GDP gap. The transformations of leverage ratio perform weaker but have at least the correct sign. The level of loans to deposits ratio has a statistically significant positive sign and indicative power similar to the leverage ratio. There is also similar weak evidence in support of the changes in total assets to GDP ratio. The robustness checks with alternative crisis datasets suggest that also the indicators related to cross border loans to GDP ratio could signal banking crises. In particular, the level and differences in both the own currency cross border loans to GDP ratio and foreign currency cross border loans to GDP ratio have strong indicative power with the LV crisis dataset and also some indicative power with the HoR crisis dataset. For the remaining indicators that measure non-core liabilities and short-term liabilities relative to liquid assets, there are some encouraging results, however the amount of crises and observations is rather low.

5 Interpretation of the indicators to guide policy

So far we identified EWIs for the policy maker to monitor in order to detect if vulnerability towards systemic banking crisis has increased. However, it is not enough for the policy maker to know which indicators are good EWIs for crisis, but they also need to know how to interpret these EWIs, i.e. what different levels of EWIs mean e.g. in terms of probability of a crisis over a pre-specified horizon.

For most of the EWIs the interpretation is clear in the sense that the higher (or lower, but not both) the value of the indicator, the more likely it is that the economy is in a credit driven boom and crisis probability is increasing. However, the policy maker also has to decide at which level of the EWI (threshold level) the signal given by the EWI is strong enough in terms of the cost-benefit trade-off of policy actions, i.e. based on given signals of the EWIs, when can the policy maker be sure enough that the economy is vulnerable in order to execute the policy action which would mitigate the potential crisis but also come with costs to the economy (Drehmann and Juselius, 2014). Using a more strict threshold leads to more missed crises and less false alarms.

Perhaps the simplest way to apply an EWI is to look at the historical or cross-country statistical distributions of the indicator. One can e.g. compute percentiles of the EWI over time or across countries, or even a combination of the time and cross-section dimensions. This shows whether the level of the EWI is high compared to its own history or compared to the situation in other countries. The present value of an EWI can also be compared to the evolution of EWI values around banking crises and tranquil periods, as is also illustrated in Annex D for some of the EWIs. While this kind of analysis may serve as a starting point, it does not provide definite guidance on which levels of EWIs should be considered alarming. Hence, they should only be used as a trigger for more in-depth assessment and discussion instead of as a trigger for policy action.

Perhaps the most common way of identifying threshold values for EWIs is to derive them based on policy maker's preferences with respect to false alarms and missed crises (e.g. Drehmann et al., 2010, 2011; Alessi and Detken, 2011; Behn et al., 2013; Detken et al., 2014). In these methods one makes an assumption about the policy maker's preferences in order to identify the thresholds, e.g. by assuming which is the optimal noise-to-signal ratio or a specific formula for policy maker's loss function with respect to missed crises and false alarms.

Given that it is very difficult to assess the expected costs and benefits of macroprudential policy, it is also very difficult to specify the optimal trade-off. Hence, the assumptions made about the policy maker's preferences might be arbitrary. To address this issue, Ferrari and Pirovano (2015) present a novel methodology for determining thresholds that is based on moments of an indicator's statistical distributions conditional on crisis periods and tranquil periods. Ferrari and Pirovano (2015) show that their method performs as well as model based methods presented above, but has the advantage of relying only on the empirical properties of the indicators instead of making difficult assumptions about the policy maker's preferences.

Many studies have suggested that multivariate models give better signals on future crisis than univariate models. However, as Detken et al. (2014) show, deriving thresholds from multivariate signaling models might be complicated, as some indicators might signal crisis earlier than others and thus they might not work well together. Also the data availability of the indicators vary and might have an effect

on the results of the multivariate model. Hence, one could end up having counter-intuitive thresholds for some indicators in the multivariate approach.

All in all, determining a threshold for an indicator is a delicate matter. Another issue is related to the fact that thresholds derived from the pooled data set might not be optimal for all the countries due to the differences in the political or institutional settings in different countries. E.g. Ferrari and Pirovano (2015) showed that their threshold method based on conditional moments works much better when taking into account the country specificities. On the other hand, country-specific thresholds might have higher uncertainty caused by fewer data.

EWIs can also be used without pre-determined thresholds. Taipalus (2012) and Philips et al. (2013) have studied time-series properties of housing market and stock market indicators and found that the time-series dynamics, such as stationarity or growth rate, of the indicator changes when there is a price bubble. Hence, one could consider signals derived from changes in the time-series dynamics of an indicator as a complementary or alternative to the signals provided by the level of the indicator.

Given that there are significant uncertainties related to every potential method of determining thresholds, one should use them carefully. Perhaps it would be wise to aim for a wider interpretation of the indicators than aiming for one set of thresholds. One could use different methods in order to get a comprehensive picture of all the information provided by different indicators.

While more careful analysis on different threshold methods is outside the scope of this work, we tabulate in Annex E statistics related to specific values of the indicators. We report different percentiles of the indicators' values during pre-crisis periods together with the false positive rate (fraction of false alarms if the percentile is viewed as a signaling threshold), false negative rates (fraction of missed crises if the percentile is viewed as a signaling threshold), and the probability to be in a vulnerable state if the indicator is at the percentile value. These numbers should be helpful in considering what a given value of indicator means in the light of earlier banking crises. However, none of this should be applied blindly as there may exist country specific effects and issues related to exact data definitions.

The methods mentioned above focus on finding threshold values for the indicators or other ways of signaling about the increase in the vulnerabilities in order to issue

warning signals to policy makers. The policy makers would then take the warning signals into account when practicing judgment about the level of the CCB. The decision problem of the policy maker is to choose a suitable level of CCB within the range 0-2.5 % given the current value of CCB and other prevailing conditions. In addition to the values of the EWIs, the policy maker may take into account issues such as other macroprudential instruments, state of the economy and monetary policy.¹⁴ According to CRD IV and the ESRB recommendation the authorities should use guided discretion in setting the CCB rate. As a starting point the authorities should use the methodology developed by BCBS to promote international consistency. The BCBS guidance sets the CCB to 0 % if credit-to-GDP gap is below 2 %, and CCB to 2.5 % if credit-to-GDP gap is more than 10 %. If credit-to-GDP gap is between 2 % and 10 %, the CCB is given by $0.3125GAP - 0.625$.¹⁵ BCBS guidance is in a sense a reasonable ad-hoc solution to the complex decision problem. As the guidance may at times be inappropriate, the policy maker needs to practice judgment and take into account a range of quantitative and qualitative information that indicates the build-up of system-wide risk. The various approaches referenced above to interpret the additional EWIs will help policy makers to practice this judgment in setting the appropriate CCB rate.

6 Conclusions

We empirically identified a set of additional early warning indicators that satisfy the policy requirements as laid down in the EU capital requirements directive (CRD IV 2013/36/EU) and the ensuing ESRB recommendation that defines categories for the indicators to be monitored. The empirical analysis is based on a panel data of EU countries and 50 indicators motivated by conceptual reasoning or by previous literature. As best EWIs we selected indicators able to distinguish between the tranquil and pre-crisis vulnerable state that also contain information on vulnerabilities

¹⁴Other macroprudential instruments include loan-to-value limits of mortgages, risk weights, buffers for systemically important institution, etc. To complicate matters further, policy maker may simultaneously make decision on other macroprudential instruments, whose effect might amplify or counter the impact of CCB.

¹⁵CCB is set quarterly between 0 % and 2.5 % of risk weighted assets calibrated in steps of 0.25 percentage points or multiples of 0.25 percentage points. In case CCB is increased, banks need to satisfy the increased capital requirement in 12 months' time, while a reduction in CCB applies immediately.

additional to what is captured by the primary indicator credit-to-GDP gap. Some of the indicators and transformations have only marginal performance differences, so we often recommend several indicators from one category.

Earlier literature has found private sector credit-to-GDP gap to be the best single indicator in predicting banking crises. This is what we also find, while we also find that the trend gap and various other transformations of household credit to GDP ratio and bank credit to GDP ratio perform equally well. For the measures of credit developments category we therefore recommend some transformation of the household credit to GDP and bank credit to GDP to be used.

We recommend some transformations of household debt to income ratio and debt service ratio to be used as an indicator in the private sector debt burden category. The results also indicate that a simple interest expense to GDP ratio can work as a useful indicator, so we recommend this type of proxy to be used if debt service ratio is not available.

In the measures of potential overvaluation of property prices, we find that transformations of the house price to income ratio outperform transformations of the house price to rent ratio or real house prices, and we therefore recommend at least some transformation of the house price to income ratio to be monitored.

In the measures of external imbalances category current account to GDP ratio or its differences is the best indicator that we could find. However, this indicator is redundant in the bivariate logit model with credit-to-GDP gap included.

Among measures of potential mispricing of risk, the high-yield spread in the euro denominated corporate bond markets and VIX index were the most informative. In addition to these risk measures of international securities markets, authorities may wish to consider other indicators for risk pricing in the national securities market or at the banks, such as stock market based indicators or banks' household or corporate lending margins that were found to be somewhat informative.

For the measures of strength of bank balance sheets category we find relatively weak evidence in support of a number of indicators: leverage ratio, loans to deposits ratio, total assets to GDP ratio and cross-border-loans to GDP ratio. The results are most robust for the leverage ratio, and we recommend it to be used optionally supported with other plausible indicators.

Our work contributes to the existing literature in that we analyze a larger set of potential indicators than any earlier study as the ESRB recommends indicators for six very different categories to be monitored. Moreover, we evaluate the performance of the indicators with the policy goal in mind, and stipulate that the indicators should have forecasting power also when evaluated jointly with the primary indicator credit-to-GDP gap. We also make careful robustness checks with alternative crisis datasets and different pre-crisis horizons, which is not conducted in many of the previous studies. To our best knowledge, our findings on the informativeness of VIX and corporate bond high-yield spread are new to the banking crisis literature.

A number of issues should be kept in mind when applying our results. First, while the results of the empirical analysis performed with panel data are more robust than those obtained with analysis on individual countries, and while "this country is different" thinking should be avoided,¹⁶ we are selecting the best performing indicators based on evidence for the average of all countries. Due to the potential institutional or other country specificities or differences in the market structure, some indicators might not work as well for some countries than for others. Therefore, it might be optimal for some countries to select different indicators than those that we propose if there is reason to believe that this country is not represented well in the average set of countries. Second, due to the aim for analysing data for as many countries as possible, we have used mainly public data sets. The national authorities who monitor the indicators of their own country should of course use the best available data. Nevertheless, we do believe that our results hold also for the indicators computed with different data sets as long as they measure the same vulnerabilities. Naturally, the threshold statistics given in Appendix E should be used with care and may not be applicable if the used datasets differ.

References

Aikman, D., Galesic, M., Gigerenzer, G., Kapadia, S., Katsikopolous, K., Kothiyal, A., Murphy, E., Neumann, T., 2014. "Taking Uncertainty Seriously: Simplicity versus Complexity in Financial Regulation" Bank of England Financial Stability Paper No. 28.

¹⁶History has shown that banking crises are caused by a group of fairly similar factors (Kauko, 2014).

Alessi, L., Detken, K., 2011. "Quasi real time early warning indicators for costly asset price boom/bust cycles: A role for global liquidity", *European Journal of Political Economy* 27, Issue 3, 520–533.

Anundsen, A., Gerdrup, K., Hansen, F., 2014. "Bubbles and crises: House prices, credit and financial market turbulence" mimeo.

Babecky, J., Havranek, T., Mateju, J., Rusnak, M., Smidkova, K., Vasicek, B., 2012. "Banking, debt and currency crises. Early warning indicators for developed countries", ECB Working Paper Series No. 1485.

Barrell, R., Davis, E.P., Karim, D., Liadze, L., 2010. "Bank regulation, property prices and early warning systems for banking crises in OECD countries", *Journal of Banking and Finance* 34, 2255-2264.

Barrell, R., Davis, E.P., Karim, D., Liadze, L., 2011. "How idiosyncratic are banking crises in OECD countries?", *National Institute Economic Review* 216, R53-R58.

Behn, M., Detken, C., Peltonen, T., Schudel W., 2013. "Setting countercyclical capital buffers based on early warning models: Would it work?", ECB Working Paper Series No. 1604.

Betz, F., Oprică, S., Peltonen, T., Sarlin, P., 2013. "Predicting Distress in European Banks". ECB Working Paper Series No 1597 / October 2013.

Bonfim, D., Monteiro, N., 2013. "The implementation of the countercyclical capital buffer: rules versus discretion," *Economic Bulletin and Financial Stability Report Articles*, Banco de Portugal, Economics and Research Department.

Bordo, M.D., Meissner, C.M., 2012. "Does inequality lead to a financial crisis?" *Journal of International Money and Finance* 31, 2147-2161.

Borio, C., Drehmann, M., 2009. "Assessing the risk of banking crises – revisited", *BIS Quarterly Review*, March: 29–46.

BCBS (Basel Committee on Banking Supervision), 2011. "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems", Bank for International Settlements. Basel, Switzerland.

Bunda, I., Ca'Zorzi, M., 2010. "Signals from housing and lending booms", *Emerging Markets Review* 11, 1-20.

Büyükkarabacak, B., Valev, N.T., 2010. "The role of household and business credit in banking crises", *Journal of Banking and Finance* 34, 1247-1256.

Castro, C., Estrada, Á., Martínez, J., 2014. "The countercyclical capital buffer in Spain: An exploratory analysis of key guiding indicators" *Financial Stability Journal* no 27, Bank of Spain.

Detken, K., Weenen, O., Alessi, L., Bonfim, D., Boucinha, M., Castro, C., Frontczak, S., Giordana, G., Giese, J., Jahn, N., Kakes, J., Klaus, B., Lang, J., Puzanova, N., Welz, P., 2014. "Operationalising the countercyclical capital buffer: indicator selection, threshold identification and calibration options", *ERSB Occasional Paper Series* No. 5 / June 2014.

Domac, I., Martinez Peria, M.S., 2003. "Banking crises and exchange rate regimes: is there a link?" *Journal of International Economics* 61.

Drehmann, M., Borio, C., Gambacorta, L., Jimenez, G., Trucharte, C., 2010. "Countercyclical capital buffers: exploring options", *BIS Working Paper* No. 317.

Drehmann, M., Borio, C., Tsatsaronis, K., 2011. "Anchoring countercyclical capital buffers: the role of credit aggregates", *International Journal of Central Banking* 7, 189-240.

Drehmann, M., Juselius, M., 2014. "Evaluating early warning indicators of banking crises: Satisfying policy requirements", *International Journal of Forecasting* 30, 759-780.

ESRB, 2014. "Recommendation of the ESRB on guidance for setting countercyclical buffer rates", <https://www.esrb.europa.eu/pub/pdf/recommendations/2014/>.

Ferrari, S., Pirovano, M., 2015., "Early warning indicators for banking crises: a conditional moments approach.", *MPRA Paper* No. 62406.

Giese, J., Andersen, H., Bush, O., Castro, C., Farag, M., Kapadia, S., 2014. "The credit-to-GDP and complementary indicators for macroprudential policy: evidence from the UK", *International Journal of Finance and Economics* 19, 25-47.

von Hagen, J., Ho, T-K., 2007. "Money market pressure and the determinants of banking crises", *Journal of Money, Credit and Banking* 39, 1037-1066.

Hahm, J-H., Shin, H. S., Shin, K., 2013. "Non-Core Bank Liabilities and Financial Vulnerability", *Journal of Money, Credit and Banking* 45, Supplement 1, 3-36.

Jordá, Ò., Schularick, M. Taylor, A.M., 2011. "Financial crises, credit booms and external imbalances: 140 years of lessons", *IMF Economic Review* 59, 340-378.

Joyce, J., 2011. "Financial globalization and banking crises in emerging markets", *Open Economies Review* 22, 875-895.

Kamin, S., DeMarco, L., 2012. "How did a domestic housing slump turn into a global financial crisis?", *Journal of International Money and Finance* 31, 10-41.

Kaminsky, G., Reinhart, C., 1999. "The twin crises: the causes of banking and balance-of-payments problems", *IMF Staff Papers* 45.

Kauko, K., 2012a. "Triggers for countercyclical capital buffers", *BoF Online* 7/2012.

Kauko, K., 2012b. "External deficits and non-performing loans in the recent financial crisis", *Economic Letters*, 115, 196-199.

Kauko, K., 2014. "How to foresee banking crises? A survey of the empirical literature", *Economic Systems* 38, 289-308.

Kauko, K., Vauhkonen, J., Topi, J., 2014. "How should the countercyclical capital buffer requirement be applied?", *Bank of Finland Bulletin* 2/2014.

Laeven, L., Valencia, F., 2008. "Systemic Banking Crises: A New Database", *International Monetary Fund*, WP/08/224.

Laeven, L., Valencia, F., 2012. "Systemic Banking Crises: A New Database", *International Monetary Fund*, WP/12/163.

Lainà, P., Nyholm, J., Sarlin, P., 2015. "Leading Indicators of Systemic Banking Crises: Finland in a Panel of EU Countries", *Review of Financial Economics* 24, 18-35.

Lo Duca, M., Peltonen, T., 2013. "Assessing systemic risks and predicting systemic

events", *Journal of Banking and Finance* 37, 2183-2195.

Phillips, P. C. B., Shi, S., Yu, J., 2013. "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500", *Cowles Foundation Discussion Papers: 1914*, 2013, 45..

Repullo, R., Saurina, J., 2011. "The countercyclical capital buffer of Basel III: A critical assessment", *CEPR Discussion Papers*, No. 8304.

Roy, S., Kemme, D.M., 2012. "Causes of banking crises: deregulation, credit booms and asset bubbles, then and now", *International Review of Economics and Finance* 24, 270-294.

Schularick, M., Taylor, A.M., 2012. "Credit booms gone bust: monetary policy, leverage cycles and financial crises 1870-2008", *American Economic Review* 102, 1029-1061.

Taipalus, K., 2012. "Detecting asset price bubbles with time-series methods", *Suomen Pankki*, E:47.

Taylor, A., 2013. "External Imbalances and Financial Crises", *IMF working paper* No 260.

Annex A: Details of the banking crisis databases and pre-crisis indicators.

Table A1. Banking crisis definitions of alternative datasets.

Dataset	Banking crisis definition
ESCB Heads of Research, Babecky et al. (2012)	Significant signs of financial distress in the banking system as evidenced by bank runs or losses (non-performing loans above 20 % or bank closures amounting to at least 20 % of banking system assets).
Detken et al. (2014)	ESCB Heads of Research dataset amended with following changes. Non-systemic banking crises and crises not associated with credit cycle excluded. "Would be crisis" added to periods where domestic developments related to credit cycle could have caused a systemic banking crisis had it not been for policy action or an external event that dampened the financial cycle.
Laeven & Valencia (2012)	A banking crisis is defined as systemic if two conditions are met: 1) Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations) 2) Significant banking policy intervention measures in response to significant losses in the banking system.
Reinhart & Rogoff (2010)	Two types of events: (i) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; or (ii) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions.

Table A1. Definitions of the banking crisis periods in various datasets.

Country	ESCB Heads of Research		ESRB CCB Group		Laeven & Valencia		Reinhart & Rogoff		Code
	Start	End	Start	End	Start	End	Start	End	
Austria	2008Q1	2008Q4			2008M9	2010*	2008	2010	AT
Belgium	2008Q1	2008Q4			2008M9	2010*	2008	2010	BE
Bulgaria	1971Q1	1971Q2					excluded		BG
	1994Q1	1997Q4	1995Q2	1997Q4	1996M1	1997			BG BG
			2004Q4**	2007Q2					BG
Croatia			1998Q1	2000Q2	1998M3	1999	excluded		HR
Cyprus	2012Q2***	2012Q4*	2012Q2	2012Q4*	excluded	excluded	excluded		CY
Czech Republic	1991Q1	1991Q4					excluded		CZ
	1994Q1	2000Q4	1998Q1	2002Q2	1996M6	2000			CZ
Denmark	1987Q1	1993Q4	1987Q1	1993Q4			1987	1992	DK
	2008Q1	2010Q4	2008Q3	2012Q4*	2008M9	2010*	2008	2010	DK
Estonia	1992Q1	1995Q4			1992M11	1994	excluded		EE
	1998Q1	1998Q4	1998Q2	1998Q4					EE
Finland	1991Q1	1995Q4	1991Q3	1995Q4	1991M9	1995	1991	1994	FI
France	1994Q1	1995Q4	1993Q3	1995Q4			1994	1995	FR
	2008Q1	2009Q4	2008Q3	2012Q4*	2008M9	2010*	2008	2010	FR
Germany	1974Q2	1974Q4					1977	1979	DE
	1977Q1	1979Q4							DE
			2000Q1	2003Q4					DE
	2008Q1	2008Q4			2008M9	2010*	2008	2010	DE
Greece	1991Q1	1995Q4					1991	1995	GR
	2008Q1	2010Q4	2008Q1	2012Q4*	2008M8	2010*	2008	2010	GR
Hungary	1991Q1	1995Q4			1991M9	1995	1991	1995	HU
	2008Q1	2009Q2	2008Q3	2012Q4*	2008M9	2010*	2008	2010	HU
Ireland	1985Q1	1985Q1							IE
	2007Q1	2010Q4	2008Q3	2012Q4*	2008M9	2010*	2007	2010	IE
Italy	1990Q1	1995Q4	1994Q1	1995Q4			1990	1995	IT
					2008M9	2010*			IT
Latvia	1995Q1	2003Q4			1995M4	1996	excluded		LV
	2008Q1	2008Q4	2008Q4	2010Q3	2008M9	2010*			LV
Lithuania	1995Q1	1996Q4	1995Q1	1996Q4	1995M12	1996	excluded		LT
	2009Q1	2009Q4	2008Q4	2010Q4					LT
Luxembourg	2008Q1	2010Q4			2008M9	2010*	excluded		LU
Netherlands			2002Q1**	2003Q4					NL
	2008Q1	2008Q4	2008Q3	2012Q4*	2008M9	2010*	2008	2010	NL
Poland	1991Q1	1994Q4			1992	1994	1991	1995	PL
Portugal			1999Q1**	2000Q1					PT
	2008Q1	2008Q4	2008Q4	2012Q4*	2008M9	2010*	2008	2010	PT
Romania	1990Q1	1999Q4			1990	1992	1990	1999	RO
			1997Q2	1999Q1					RO
Slovak Republic	1991Q1	2002Q4			1998	2002	excluded		SK
Slovenia	1992Q1	1994Q4	1992Q1	1994Q4	1992	1992	excluded		SI
	2008Q1	2008Q4	2008Q1	2012Q4*	2008M9	2010*			SI
Spain	1977Q1	1985Q4	1978Q1	1985Q3	1977	1981	1977	1985	ES
	2008Q1	2008Q4	2009Q2	2012Q4	2008M9	2010*	2008	2010	ES
Sweden	1990Q3	1995Q4	1990Q3	1993Q4	1991M9	1995	1991	1994	SE
	2008Q1	2008Q4	2008Q3	2010Q4	2008M9	2010*			SE
United Kingdom	1974Q1	1976Q4	1973Q4	1975Q4			1974	1976	UK
	1984Q1	1984Q4					1984	1984	UK
	1991Q1	1995Q4	1990Q3	1994Q2			1991	1991	UK
	2007Q1	2007Q4					1995	1995	UK
			2007Q3	2012Q4*	2007M9	2010*	2007	2009	UK

Figure A1. Illustration of the pre-crisis periods for the 1 to 3 year horizon evaluation for Detken et al. crisis dataset.

= tranquil period
 = pre-crisis period
 = crisis period
 = other excluded period

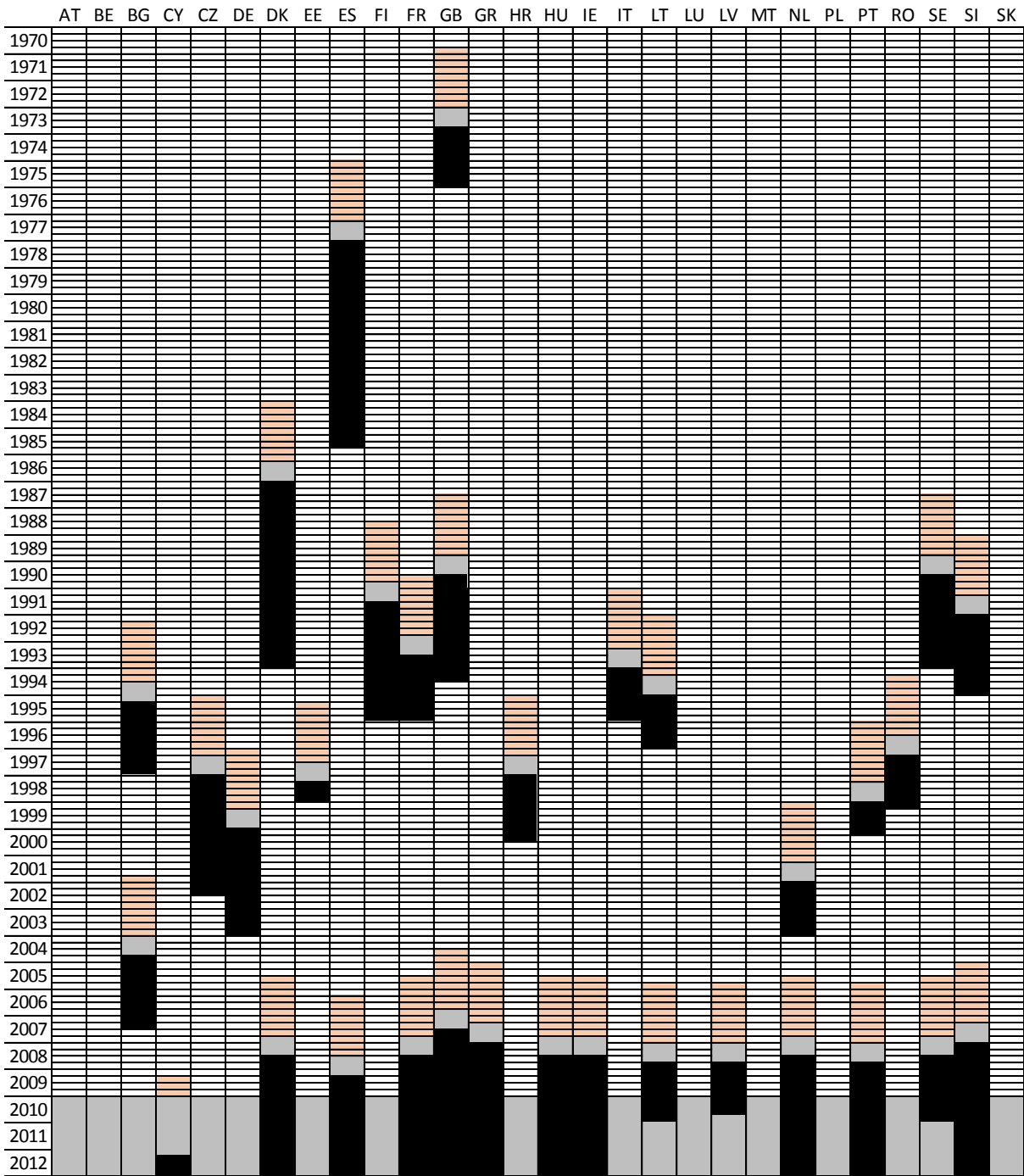
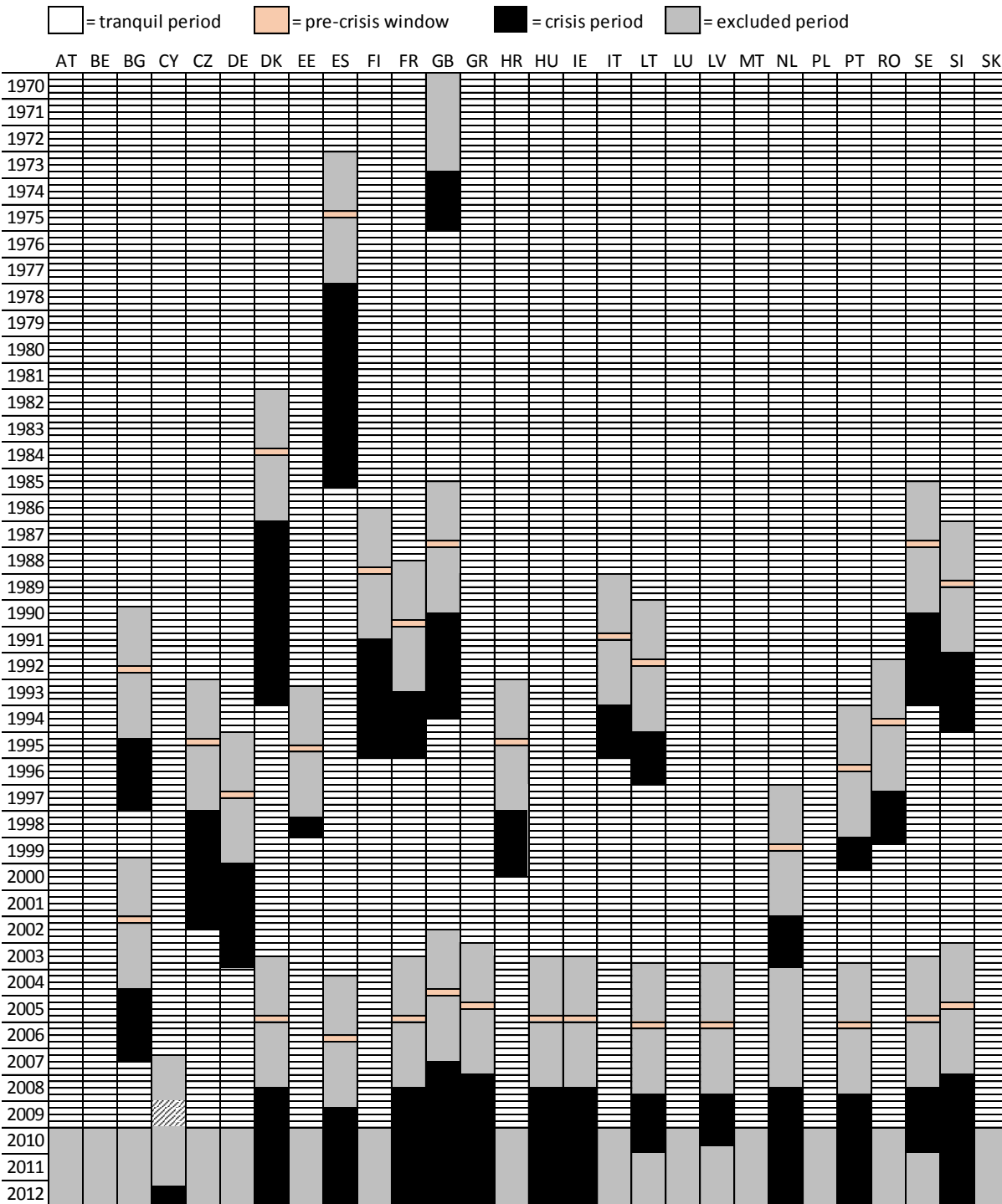


Figure A2. Illustration of the constructed pre-crisis variable for the evaluation with rolling pre-crisis window for the case of ESRB CCB Group crisis database and the forecast horizon equal to 11 quarters. 5 years of data prior to the crisis is excluded except for the one quarter 11 quarters before the crisis. Only those crises are utilized for which there is at least 20 quarters of indicator data prior to the crisis and the data does not overlap with other crises during that period.



Annex B: Full evaluation results with all crisis datasets.

The transformations of indicators presented in the tables are defined as follows:

'3y growth' is calculated as $100 (x_t - x_{t-12})/x_{t-12}$.

'1y growth' is calculated as $100 (x_t - x_{t-4})/x_{t-4}$.

'3y difference' is calculated as $x_t - x_{t-12}$.

'1y difference' is calculated as $x_t - x_{t-4}$.

'trend gap' is calculated as $x_t - trend_t$, where the trend is calculated using one-sided Hodrick-Prescott filter with smoothing parameter $\lambda = 400,000$.

'relative gap' is calculated as $100 x_t/trend_t$, where the trend is calculated using one-sided Hodrick-Prescott filter with smoothing parameter $\lambda = 400,000$.

'5y m.a. gap' is the deviation from the 5 year moving average calculated as $x_t - \sum_{i=0}^{19} x_{t-i}/20$.

'm.a. gap' is the deviation from the recursive mean calculated as $x_t - \sum_{s=t_0}^t x_s/(t - t_0 + 1)$, where t_0 is the time of first observation.

'1y diff. / 5y m.a.' refers to the one-year difference in credit divided by 5 year moving average GDP, and it is calculated as $(C_t - C_{t-4})/ \sum_{i=0}^{19} GDP_{t-i}/20$, where C is the credit aggregate variable.

Table B1. All early-warning evaluation results for each indicator category with Detken et al. (2014) crisis dataset. Evaluation horizon is 1 to 3 years. Statistical significance and larger |AUC-0.5| indicates better performance. pR2 is pseudo R2, Cr is the number of crises, Co is the number of countries, N is the number of observations.

Panel A: Measures of credit developments, Detken et al. crisis dataset

Indicator	Transformation	univariate				bivariate				Indicator				Credit-to-GDP gap					
		AUC	Logit coeff.	pR2	Cr	Co	N	AUC	Logit coeff.	pR2	Cr	Co	N	Logit coeff.	pR2	Cr	Co	N	
Total credit (real)	3y growth	0.68***	(0.04)	0.018**	(0.009)	0.030	12	15	1182	0.83***	(0.03)	-0.011	(0.009)	9.681***	(1.421)	0.172	12	15	1147
	1y growth	0.69***	(0.03)	0.034	(0.027)	0.018	14	15	1274	0.81***	(0.04)	8.0e-03	(1.3e-02)	8.213***	(1.045)	0.157	13	15	1194
	relative gap	0.76***	(0.04)	0.058***	(0.016)	0.081	12	15	1108	0.82***	(0.03)	0.016	(0.024)	7.574***	(1.669)	0.169	12	15	1108
Total bank credit (real)	3y growth	0.74***	(0.03)	0.022***	(0.008)	0.056	12	15	1163	0.82***	(0.03)	3.5e-03	(5.4e-03)	8.205***	(1.209)	0.168	12	15	1135
	1y growth	0.70***	(0.05)	0.037	(0.029)	0.023	14	15	1255	0.81***	(0.03)	0.016	(0.010)	8.014***	(1.038)	0.160	13	15	1190
	relative gap	0.79***	(0.05)	0.043***	(0.011)	0.078	12	15	1089	0.83***	(0.04)	0.018	(0.017)	7.306***	(1.369)	0.173	12	15	1089
Household credit (real)	3y growth	0.71***	(0.05)	0.016***	(0.005)	0.041	12	15	884	0.79***	(0.04)	6.6e-03*	(3.6e-03)	7.815***	(1.057)	0.167	12	15	873
	1y growth	0.65***	(0.04)	0.022*	(0.012)	0.010	14	15	973	0.78***	(0.04)	9.6e-03	(7.4e-03)	7.590***	(0.917)	0.144	13	15	937
	relative gap	0.69**	(0.07)	0.044***	(0.016)	0.047	12	15	810	0.79***	(0.03)	0.030**	(0.015)	7.310***	(1.151)	0.160	12	15	810
Corporate credit (real)	3y growth	0.61*	(0.05)	0.011	(0.011)	0.011	12	15	884	0.83***	(0.04)	-0.035***	(0.013)	11.613***	(1.705)	0.187	12	15	873
	1y growth	0.70***	(0.04)	0.035	(0.035)	0.022	14	15	973	0.79***	(0.03)	8.7e-03	(1.4e-02)	7.490***	(0.888)	0.144	13	15	937
	relative gap	0.60**	(0.05)	0.030	(0.021)	0.013	12	15	810	0.79***	(0.04)	-0.039	(0.027)	9.713***	(1.828)	0.151	12	15	810
Total credit / GDP		0.73***	(0.05)	0.917*	(0.502)	0.066	22	18	2132	0.84***	(0.04)	0.381	(0.419)	8.459***	(1.657)	0.173	20	18	1803
	3y growth	0.56	(0.06)	5.8e-03	(9.6e-03)	0.002	21	18	1916	0.83***	(0.04)	-8.4e-03	(1.6e-02)	10.249***	(2.140)	0.169	20	18	1803
	1y growth	0.59*	(0.05)	0.031	(0.024)	0.007	22	18	2060	0.83***	(0.03)	-7.9e-04	(3.5e-02)	9.888***	(1.976)	0.167	20	18	1803
	3y difference	0.81***	(0.04)	3.038	(2.837)	0.064	21	18	1916	0.83***	(0.03)	-1.069	(1.350)	11.358***	(2.473)	0.169	20	18	1803
	1y difference	0.79***	(0.04)	6.636	(6.839)	0.053	22	18	2060	0.83***	(0.03)	-0.643	(3.069)	10.254***	(2.280)	0.167	20	18	1803
	trend gap	0.83***	(0.03)	9.875***	(1.657)	0.167	20	18	1803	0.83***	(0.03)	9.875***	(1.657)	0.0e+00	()	0.167	20	18	1803
	relative gap	0.73***	(0.04)	0.065***	(0.019)	0.075	20	18	1803	0.83***	(0.03)	1.7e-03	(2.5e-02)	9.767***	(2.601)	0.167	20	18	1803
	5y m.a. gap	0.81***	(0.04)	6.400	(5.221)	0.085	20	18	1803	0.83***	(0.03)	-1.036	(2.252)	10.812***	(2.492)	0.168	20	18	1803
	m.a. gap	0.78***	(0.04)	2.668***	(0.450)	0.153	20	18	1803	0.83***	(0.04)	1.390**	(0.693)	6.087***	(1.889)	0.183	20	18	1803
	1y diff. / 5y m.a.	0.79***	(0.05)	6.356	(6.497)	0.069	22	18	2072	0.84***	(0.03)	2.823	(7.892)	8.091**	(4.098)	0.171	20	18	1803
	Total bank credit / GDP		0.74***	(0.05)	2.817***	(0.556)	0.140	22	18	2100	0.83***	(0.04)	1.919**	(0.808)	6.148***	(1.830)	0.200	20	18
3y growth		0.61*	(0.07)	0.014	(0.011)	0.015	21	18	1884	0.82***	(0.02)	1.9e-03	(1.4e-02)	9.732***	(2.070)	0.166	20	18	1785
1y growth		0.60**	(0.05)	0.040*	(0.024)	0.012	22	18	2028	0.82***	(0.02)	0.019	(0.033)	9.612***	(1.889)	0.169	20	18	1799
3y difference		0.84***	(0.04)	10.687***	(2.615)	0.181	21	18	1884	0.85***	(0.04)	6.657**	(3.326)	4.480*	(2.621)	0.185	20	18	1785
1y difference		0.77***	(0.05)	21.925***	(5.574)	0.143	22	18	2028	0.84***	(0.03)	11.444	(7.452)	6.198***	(2.279)	0.183	20	18	1799
trend gap		0.83***	(0.03)	12.800***	(2.724)	0.172	20	18	1771	0.84***	(0.03)	7.492*	(4.530)	4.756	(3.220)	0.178	20	18	1771
relative gap		0.74***	(0.04)	0.061***	(0.013)	0.091	20	18	1771	0.82***	(0.03)	0.014	(0.022)	8.772***	(2.460)	0.168	20	18	1771
5y m.a. gap		0.84***	(0.04)	16.075***	(4.065)	0.179	20	18	1771	0.85***	(0.04)	10.516*	(5.409)	4.258	(2.712)	0.186	20	18	1771
m.a. gap		0.80***	(0.05)	4.858***	(0.976)	0.192	20	18	1771	0.84***	(0.04)	3.440***	(1.252)	4.276**	(2.059)	0.205	20	18	1771
1y diff. / 5y m.a.		0.80***	(0.05)	19.686***	(5.559)	0.169	22	18	2040	0.85***	(0.04)	14.634*	(7.671)	4.301**	(1.915)	0.202	20	18	1799
Total household credit / GDP			0.72***	(0.04)	3.576***	(0.696)	0.128	20	18	1453	0.85***	(0.02)	2.833***	(0.901)	6.574***	(1.638)	0.227	18	18
	3y growth	0.60*	(0.06)	2.4e-03	(3.0e-03)	0.002	18	18	1255	0.83***	(0.03)	-8.0e-04	(5.1e-03)	9.943***	(1.555)	0.179	18	18	1226
	1y growth	0.57	(0.05)	1.8e-04	(9.5e-03)	0.000	20	18	1385	0.84***	(0.02)	-0.013	(0.021)	9.754***	(1.449)	0.177	18	18	1299
	3y difference	0.85***	(0.03)	20.652***	(2.497)	0.266	18	18	1255	0.85***	(0.03)	19.135***	(4.442)	1.093	(2.743)	0.262	18	18	1226
	1y difference	0.79***	(0.04)	39.528***	(5.554)	0.163	20	18	1385	0.85***	(0.02)	26.071**	(11.659)	5.165**	(2.095)	0.205	18	18	1299
	trend gap	0.83***	(0.03)	25.078***	(5.306)	0.171	18	18	1150	0.85***	(0.03)	15.470**	(7.005)	5.442**	(2.192)	0.194	18	18	1150
	relative gap	0.70***	(0.05)	0.046***	(0.014)	0.053	18	18	1150	0.81***	(0.03)	0.016	(0.017)	9.129***	(2.021)	0.170	18	18	1150
	5y m.a. gap	0.85***	(0.03)	32.379***	(4.017)	0.246	18	18	1150	0.85***	(0.03)	30.736***	(7.225)	0.831	(2.820)	0.246	18	18	1150
	m.a. gap	0.82***	(0.03)	8.082***	(1.319)	0.189	18	18	1150	0.87***	(0.02)	5.686***	(1.354)	5.534***	(2.060)	0.224	18	18	1150
	1y diff. / 5y m.a.	0.80***	(0.04)	35.140***	(6.487)	0.202	20	18	1389	0.86***	(0.03)	29.554***	(10.341)	3.976**	(1.858)	0.244	18	18	1299
	Total corporate credit / GDP		0.72***	(0.04)	0.639	(0.513)	0.021	19	18	1441	0.82***	(0.02)	-0.279	(0.584)	10.258***	(1.930)	0.177	18	18
3y growth		0.57	(0.05)	7.4e-03	(8.5e-03)	0.004	18	18	1243	0.84***	(0.03)	-0.021*	(0.013)	11.330***	(1.569)	0.191	18	18	1214
1y growth		0.64***	(0.04)	0.047**	(0.021)	0.022	19	18	1373	0.83***	(0.03)	3.1e-03	(2.5e-02)	9.547***	(1.293)	0.175	18	18	1295
3y difference		0.67***	(0.05)	1.525	(1.558)	0.014	18	18	1243	0.84***	(0.04)	-10.443**	(5.066)	17.958***	(4.324)	0.221	18	18	1214
1y difference		0.76***	(0.03)	3.885	(5.010)	0.021	19	18	1373	0.83***	(0.02)	-2.847	(1.837)	10.865***	(1.696)	0.181	18	18	1295
trend gap		0.68***	(0.05)	8.066***	(3.024)	0.049	18	18	1131	0.86***	(0.03)	-24.712***	(5.174)	23.896***	(3.599)	0.245	18	18	1131
relative gap		0.66***	(0.05)	0.068***	(0.018)	0.054	18	18	1131	0.82***	(0.03)	-0.067**	(0.033)	14.041***	(2.196)	0.181	18	18	1131
5y m.a. gap		0.69***	(0.04)	9.357***	(3.339)	0.064	18	18	1131	0.82***	(0.03)	-12.229*	(7.108)	16.033***	(4.237)	0.186	18	18	1131
m.a. gap		0.71***	(0.05)	2.550**	(1.256)	0.044	18	18	1131	0.80***	(0.03)	-0.938	(1.535)	11.062***	(2.683)	0.167	18	18	1131
1y diff. / 5y m.a.		0.79***	(0.03)	3.975	(6.389)	0.027	19	18	1377	0.83***	(0.02)	-0.976	(1.728)	10.095***	(1.529)	0.176	18	18	1295

Robust standard errors adjusted for clustering are reported in the parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1%-level.

Panel B: Measures of private sector debt burden, Detken et al. crisis dataset

Indicator	Transformation	univariate							bivariate				Credit-to-GDP gap				
		AUC	Indicator Logit coeff.	pR2	Cr	Co	N	AUC	Indicator Logit coeff.	Logit coeff.	pR2	Cr	Co	N			
Household credit / Gross disposable income		0.69***	(0.05) 5.5e-04***	(7.9e-05)	0.033	15	11	1091	0.82***	(0.03) 5.8e-04***	(1.1e-04)	9.521***	(1.343)	0.214	15	11	1089
	3y growth	0.78***	(0.05) 0.078***	(0.019)	0.167	15	11	975	0.82***	(0.04) 0.048*	(0.028)	6.723***	(1.841)	0.219	15	11	975
	1y growth	0.71***	(0.04) 0.160***	(0.032)	0.090	15	11	1055	0.82***	(0.03) 0.076	(0.053)	8.131***	(1.444)	0.195	15	11	1055
	3y difference	0.79***	(0.05) 2.6e-03***	(3.0e-04)	0.042	15	11	975	0.82***	(0.03) 2.5e-03***	(4.4e-04)	9.371***	(1.462)	0.218	15	11	975
	1y difference	0.78***	(0.04) 6.5e-03***	(8.0e-04)	0.031	15	11	1055	0.83***	(0.03) 6.3e-03***	(1.2e-03)	9.403***	(1.353)	0.209	15	11	1055
	trend gap	0.82***	(0.04) 4.5e-03***	(4.6e-04)	0.048	15	11	905	0.81***	(0.04) 4.1e-03***	(7.3e-04)	8.828***	(1.509)	0.198	15	11	905
	relative gap	0.78***	(0.05) 0.096***	(0.030)	0.126	15	11	905	0.82***	(0.04) 0.061	(0.039)	6.667***	(1.794)	0.190	15	11	905
	5y m.a. gap	0.80***	(0.05) 4.0e-03***	(4.9e-04)	0.041	15	11	905	0.80***	(0.03) 3.8e-03***	(7.4e-04)	8.926***	(1.550)	0.193	15	11	905
	m.a. gap	0.77***	(0.05) 1.3e-03***	(1.3e-04)	0.046	15	11	905	0.81***	(0.04) 1.2e-03***	(2.0e-04)	8.918***	(1.552)	0.198	15	11	905
	Debt-service-ratio (BIS)		0.72***	(0.04) 0.062	(0.041)	0.030	16	12	1333	0.82***	(0.03) 0.017	(0.030)	9.436***	(1.749)	0.154	16	12
3y growth		0.62**	(0.06) 0.028**	(0.014)	0.029	16	12	1201	0.82***	(0.03) -1.2e-03	(1.6e-02)	9.486***	(2.093)	0.146	16	12	1187
1y growth		0.71***	(0.04) 0.104***	(0.025)	0.073	16	12	1289	0.80***	(0.03) 0.069***	(0.022)	8.572***	(1.950)	0.175	16	12	1259
3y difference		0.63**	(0.06) 0.185*	(0.095)	0.038	16	12	1201	0.81***	(0.03) 9.6e-03	(6.6e-02)	9.281***	(2.039)	0.146	16	12	1187
1y difference		0.73***	(0.04) 0.573***	(0.217)	0.086	16	12	1289	0.80***	(0.03) 0.329**	(0.148)	8.306***	(1.882)	0.176	16	12	1259
trend gap		0.70***	(0.05) 0.242***	(0.078)	0.068	16	12	1124	0.81***	(0.03) -1.0e-02	(1.2e-01)	9.301***	(3.093)	0.142	16	12	1124
relative gap		0.70***	(0.05) 0.049***	(0.014)	0.067	16	12	1124	0.81***	(0.03) -5.3e-03	(2.7e-02)	9.602***	(3.255)	0.142	16	12	1124
5y m.a. gap		0.67***	(0.05) 0.399***	(0.144)	0.068	16	12	1124	0.79***	(0.03) 0.125	(0.157)	8.113***	(2.148)	0.147	16	12	1124
m.a. gap		0.65*	(0.08) 0.134	(0.118)	0.033	16	12	1124	0.80***	(0.03) 0.054	(0.077)	8.729***	(1.676)	0.148	16	12	1124
Debt-service-ratio (ESRB)			0.61**	(0.05) 1.817**	(0.715)	0.014	26	26	2280	0.82***	(0.03) 2.147***	(0.439)	9.435***	(1.681)	0.182	19	17
	3y growth	0.74***	(0.03) 0.020***	(0.006)	0.058	23	25	1989	0.81***	(0.02) 0.029***	(0.010)	7.560***	(1.935)	0.180	19	17	1476
	1y growth	0.75***	(0.02) 0.049**	(0.022)	0.049	25	26	2185	0.82***	(0.02) 0.075***	(0.026)	7.889***	(1.768)	0.191	19	17	1516
	3y difference	0.77***	(0.03) 23.761**	(10.510)	0.093	23	25	1989	0.82***	(0.03) 11.411**	(5.208)	7.859***	(1.868)	0.181	19	17	1476
	1y difference	0.79***	(0.02) 54.819***	(15.797)	0.109	25	26	2185	0.84***	(0.03) 40.935***	(11.498)	7.604***	(1.768)	0.216	19	17	1516
	trend gap	0.73***	(0.04) 35.962***	(10.662)	0.103	21	22	1837	0.80***	(0.03) 13.601**	(6.615)	6.953***	(1.940)	0.156	18	16	1441
	relative gap	0.71***	(0.04) 0.032**	(0.015)	0.046	21	22	1837	0.81***	(0.03) 9.2e-03	(1.9e-02)	8.229***	(2.306)	0.145	18	16	1441
	5y m.a. gap	0.78***	(0.03) 38.657**	(15.504)	0.107	21	22	1837	0.81***	(0.03) 23.129**	(9.272)	6.895***	(1.797)	0.176	18	16	1441
	m.a. gap	0.73***	(0.04) 15.981***	(4.464)	0.091	21	22	1837	0.83***	(0.03) 11.615***	(2.813)	7.474***	(1.790)	0.187	18	16	1441
	Corporate debt-service-ratio (ESRB)		0.61	(0.08) 0.762	(1.164)	0.004	18	25	1081	0.80***	(0.04) -0.495	(1.676)	8.546***	(1.592)	0.171	14	16
3y growth		0.71***	(0.05) 0.039***	(0.011)	0.102	14	23	817	0.78***	(0.05) 0.010	(0.015)	7.253***	(1.870)	0.175	12	16	757
1y growth		0.74***	(0.04) 0.073***	(0.022)	0.088	17	25	990	0.80***	(0.04) 0.048**	(0.021)	6.833***	(1.176)	0.189	13	16	844
3y difference		0.72***	(0.06) 5.525	(4.643)	0.041	14	23	817	0.79***	(0.05) -0.339	(3.053)	8.256***	(1.818)	0.172	12	16	757
1y difference		0.74***	(0.04) 9.433	(7.085)	0.032	17	25	990	0.80***	(0.04) 2.609	(7.821)	7.821***	(1.454)	0.173	13	16	844
trend gap		0.66*	(0.07) 14.029*	(7.296)	0.052	12	20	691	0.77***	(0.05) -1.496	(9.292)	7.954***	(2.635)	0.148	12	16	670
relative gap		0.64	(0.07) 0.030	(0.018)	0.027	12	20	691	0.77***	(0.05) -0.012	(0.023)	8.274***	(2.272)	0.149	12	16	670
5y m.a. gap		0.74***	(0.06) 19.385***	(7.301)	0.101	12	20	691	0.77***	(0.05) 8.283	(6.566)	6.053***	(1.813)	0.159	12	16	670
m.a. gap		0.72**	(0.09) 7.838	(4.990)	0.068	12	20	691	0.76***	(0.05) 1.837	(6.221)	6.976***	(2.468)	0.149	12	16	670
Household debt-service-ratio (ESRB)			0.67**	(0.06) 12.607***	(4.673)	0.075	18	25	1069	0.81***	(0.04) 18.129***	(6.492)	4.791***	(1.547)	0.228	14	16
	3y growth	0.68**	(0.06) 0.012**	(0.005)	0.036	15	23	795	0.77***	(0.05) 8.6e-03	(5.9e-03)	7.435***	(1.465)	0.164	13	16	735
	1y growth	0.67***	(0.05) 0.036***	(0.013)	0.036	18	25	976	0.77***	(0.05) 0.029	(0.019)	7.690***	(1.302)	0.166	14	16	830
	3y difference	0.77***	(0.06) 49.391***	(12.542)	0.161	15	23	795	0.79***	(0.06) 45.760***	(18.022)	4.449*	(2.286)	0.228	13	16	735
	1y difference	0.73***	(0.04) 76.289***	(20.140)	0.098	18	25	976	0.79***	(0.05) 73.448***	(24.632)	6.053***	(1.486)	0.207	14	16	830
	trend gap	0.70**	(0.06) 59.404***	(14.106)	0.084	13	20	668	0.76***	(0.05) 34.406	(22.042)	5.940***	(2.085)	0.152	13	16	647
	relative gap	0.63	(0.08) 0.023	(0.017)	0.018	13	20	668	0.76***	(0.05) 3.4e-03	(1.6e-02)	7.203***	(1.629)	0.136	13	16	647
	5y m.a. gap	0.78***	(0.06) 87.108***	(24.017)	0.178	13	20	668	0.79***	(0.06) 72.809**	(29.543)	4.342*	(2.220)	0.216	13	16	647
	m.a. gap	0.81***	(0.07) 57.289***	(14.976)	0.246	13	20	668	0.81***	(0.06) 49.889***	(18.140)	2.794	(2.026)	0.260	13	16	647
	Household credit * 10y interest rate / GDP		0.68***	(0.06) 0.448***	(0.159)	0.054	19	20	968	0.80***	(0.04) 0.490**	(0.192)	8.590***	(1.445)	0.216	17	17
3y growth		0.67***	(0.04) 9.8e-03**	(4.2e-03)	0.022	15	17	801	0.79***	(0.05) 2.1e-03	(4.6e-03)	8.199***	(1.528)	0.180	15	17	801
1y growth		0.61**	(0.04) 0.018***	(0.007)	0.019	16	18	907	0.79***	(0.04) 0.012	(0.008)	8.305***	(1.341)	0.178	16	17	902
3y difference		0.70***	(0.05) 1.193***	(0.370)	0.080	15	17	801	0.79***	(0.04) 0.530	(0.373)	7.436***	(1.729)	0.191	15	17	801
1y difference		0.63***	(0.04) 1.030***	(0.321)	0.037	16	18	907	0.79***	(0.04) 0.715**	(0.363)	8.134***	(1.370)	0.184	16	17	902
trend gap		0.59	(0.07) 0.709	(0.524)	0.018	13	17	708	0.77***	(0.05) 0.030	(0.690)	7.553***	(1.806)	0.151	13	17	708
relative gap		0.53	(0.07) -4.1e-04	(8.5e-03)	0.000	13	17	708	0.78***	(0.05) -7.6e-03	(1.3e-02)	7.907***	(1.726)	0.156	13	17	708
5y m.a. gap		0.71***	(0.06) 1.990***	(0.678)	0.097	13	17	708	0.76***	(0.04) 1.154	(0.723)	6.302***	(1.924)	0.174	13	17	708
m.a. gap		0.70***	(0.06) 1.079***	(0.405)	0.093	13	17	708	0.77***	(0.05) 0.671	(0.495)	6.467***	(2.012)	0.178	13	17	708
Household credit * 3m interest rate / GDP			0.63**	(0.05) 0.309**	(0.124)	0.031	20	25	1350	0.80***	(0.04) 0.465***	(0.141)	9.920***	(1.513)	0.221	17	17
	3y growth	0.72***	(0.04) 6.2e-03***	(2.0e-03)	0.065	19	25	1087	0.82***	(0.03) 7.1e-03**	(2.8e-03)	8.120***	(1.656)	0.200	17	17	969
	1y growth	0.73***	(0.03) 0.019***	(0.005)	0.083	20	25	1262	0.83***	(0.03) 0.022***	(0.005)	8.658***	(1.576)	0.232	17	17	1073
	3y difference	0.74***	(0.04) 0.814***	(0.224)	0.120	19	25	1087	0.83***	(0.03) 0.859***	(0.239)	7.658***	(1.790)	0.255	17	17	969
	1y difference	0.73***	(0.04) 1.234***	(0.383)	0.101	20	25	1262	0.83***	(0.03) 1.416***	(0.244)	8.623***	(1.714)	0.266	17	17	1073
	trend gap	0.71***	(0.06) 0.950***	(0.332)	0.084	18	25	928	0.79***	(0.04) 0.782**	(0.333)	7.056***	(1.627)	0.190	16	17	863
	relative gap	0.68***	(0.05) 8.2e-03***	(2.9e-03)	0.045	18	25	928	0.80***	(0.03) 5.0e-03*	(3.0e-03)	7.795***	(1.567)	0.167	16	17	863
	5y m.a. gap	0.77***	(0.05) 1.313***	(0.377)	0.139	18	25	928	0.83***	(0.04) 1.434***	(0.359)	7.135***	(1.953)	0.254	16	17	863
	m.a. gap																

Panel C: Measures of potential overvaluation of property prices, Detken et al. crisis dataset

Indicator	Transformation	univariate				bivariate				Credit-to-GDP gap			
		AUC	Indicator Logit coeff.	pR2	Cr Co N	AUC	Indicator Logit coeff.	Logit coeff.	pR2 Cr Co N				
Residential property real price / rent	3y growth	0.66** (0.06)	0.016** (0.007)	0.028	20 16 1444	0.81*** (0.03)	0.013 (0.012)	8.370*** (1.185)	0.166	19 14 1352			
	1y growth	0.59 (0.05)	0.021 (0.013)	0.009	22 19 1592	0.80*** (0.03)	0.022 (0.020)	8.722*** (1.229)	0.158	19 16 1404			
	relative gap	0.68*** (0.05)	0.041*** (0.015)	0.061	20 16 1339	0.81*** (0.03)	0.025 (0.017)	7.989*** (0.932)	0.180	19 14 1313			
Residential property price / income	3y growth	0.74*** (0.06)	0.021* (0.011)	0.067	22 20 1520	0.80*** (0.04)	8.4e-03 (8.1e-03)	7.879*** (1.450)	0.156	19 16 1423			
	1y growth	0.68*** (0.06)	0.017*** (0.006)	0.044	20 17 1302	0.82*** (0.02)	0.013 (0.014)	8.440*** (0.794)	0.174	18 14 1251			
	3y difference	0.60* (0.05)	0.021* (0.012)	0.010	21 19 1447	0.81*** (0.03)	0.026 (0.021)	8.812*** (1.077)	0.165	19 16 1372			
	1y difference	0.69*** (0.06)	0.042*** (0.014)	0.080	20 17 1302	0.82*** (0.03)	0.021 (0.022)	8.080*** (0.824)	0.176	18 14 1251			
	trend gap	0.62* (0.06)	0.047** (0.024)	0.024	21 19 1447	0.81*** (0.03)	0.035 (0.031)	8.687*** (1.008)	0.166	19 16 1372			
	relative gap	0.76*** (0.05)	0.065*** (0.027)	0.079	20 17 1190	0.82*** (0.03)	0.039 (0.029)	7.381*** (0.839)	0.182	18 14 1160			
	5y m.a. gap	0.66*** (0.05)	0.035*** (0.013)	0.046	20 17 1190	0.81*** (0.03)	0.026 (0.016)	7.923*** (0.798)	0.179	18 14 1160			
	m.a. gap	0.70** (0.07)	0.069*** (0.026)	0.082	20 17 1190	0.81*** (0.03)	0.033 (0.034)	7.853*** (0.714)	0.171	18 14 1160			
		0.74*** (0.06)	0.039*** (0.012)	0.121	20 17 1190	0.81*** (0.03)	6.0e-03 (1.9e-02)	7.964*** (2.072)	0.161	18 14 1160			
		0.75*** (0.05)	0.027** (0.013)	0.092	22 21 1507	0.79*** (0.04)	0.015* (0.009)	7.587*** (1.512)	0.165	19 16 1370			
Residential property price / GDP	3y growth	0.75*** (0.05)	0.045*** (0.014)	0.111	20 18 1277	0.82*** (0.03)	0.040** (0.018)	7.191*** (0.764)	0.210	18 14 1196			
	1y growth	0.64*** (0.05)	0.052*** (0.018)	0.034	21 20 1430	0.80*** (0.03)	0.050* (0.026)	8.431*** (1.075)	0.172	19 16 1317			
	3y difference	0.76*** (0.05)	0.072*** (0.019)	0.157	20 18 1277	0.82*** (0.04)	0.061** (0.027)	6.388*** (0.812)	0.218	18 14 1196			
	1y difference	0.65** (0.05)	0.082*** (0.022)	0.060	21 20 1430	0.80*** (0.03)	0.064** (0.032)	8.192*** (1.014)	0.174	19 16 1317			
	trend gap	0.78*** (0.05)	0.127*** (0.028)	0.173	19 18 1164	0.82*** (0.04)	0.081** (0.035)	6.535*** (1.216)	0.224	17 14 1111			
	relative gap	0.73*** (0.05)	0.074*** (0.018)	0.107	19 18 1164	0.82*** (0.04)	0.054** (0.023)	7.437*** (1.080)	0.212	17 14 1111			
	5y m.a. gap	0.78*** (0.05)	0.136*** (0.029)	0.194	19 18 1164	0.82*** (0.04)	0.093** (0.039)	6.633*** (0.778)	0.223	17 14 1111			
	m.a. gap	0.81*** (0.05)	0.074*** (0.014)	0.257	19 18 1164	0.82*** (0.05)	0.052** (0.023)	3.905** (1.792)	0.228	17 14 1111			

Robust standard errors adjusted for clustering are reported in the parentheses. **, * and *** indicate statistical significance at the 10%, 5% and 1%-level.

Panel D: Measures of external imbalances, Detken et al. crisis dataset

Indicator	Transformation	univariate				bivariate				Credit-to-GDP gap			
		AUC	Indicator Logit coeff.	pR2	Cr Co N	AUC	Indicator Logit coeff.	Logit coeff.	pR2 Cr Co N				
Current account / GDP		0.34*** (0.05)	-0.264*** (0.083)	0.038	22 26 1897	0.82*** (0.03)	-0.199 (0.239)	9.149*** (1.689)	0.191	17 18 1305			
	3y growth	0.56 (0.03)	-7.1e-07 (1.1e-05)	0.000	21 26 1613	0.84*** (0.03)	4.0e-06 (1.2e-05)	9.287*** (1.438)	0.182	17 18 1179			
	1y growth	0.60*** (0.03)	9.3e-06 (1.0e-05)	0.000	22 26 1804	0.84*** (0.03)	1.3e-06 (9.2e-06)	9.549*** (1.422)	0.184	17 18 1271			
	3y difference	0.34*** (0.04)	-0.352*** (0.122)	0.031	21 26 1614	0.82*** (0.03)	-0.434 (0.306)	8.455*** (1.621)	0.193	17 18 1179			
	1y difference	0.39*** (0.03)	-0.272** (0.118)	0.011	22 26 1805	0.84*** (0.03)	-0.516** (0.219)	9.231*** (1.386)	0.193	17 18 1271			
Capital account / GDP		0.60* (0.06)	69.335 (66.213)	0.004	16 21 1036	0.81*** (0.04)	67.431 (138.757)	8.056*** (1.552)	0.167	15 18 911			
	3y growth	0.46 (0.04)	2.3e-05 (4.3e-05)	0.000	12 20 736	0.79*** (0.04)	2.7e-05 (5.7e-05)	7.501*** (1.298)	0.161	12 18 668			
	1y growth	0.47 (0.03)	-8.1e-05 (6.4e-05)	0.001	15 21 893	0.80*** (0.04)	-1.0e-04 (8.0e-05)	7.961*** (1.268)	0.168	14 18 792			
	3y difference	0.54 (0.06)	3.861 (45.338)	0.000	13 20 795	0.80*** (0.04)	140.458 (156.725)	8.070*** (1.419)	0.174	13 18 725			
	1y difference	0.50 (0.03)	2.095 (17.181)	0.000	16 21 952	0.80*** (0.04)	68.849 (71.882)	8.158*** (1.331)	0.166	15 18 849			
Portfolio investments / GDP		0.48 (0.09)	0.183 (0.289)	0.003	12 21 641	0.80*** (0.06)	0.173 (0.303)	7.891*** (1.444)	0.182	11 18 554			
	3y growth	0.53 (0.07)	6.2e-05 (1.7e-04)	0.000	10 20 400	0.78*** (0.07)	2.3e-03 (1.6e-03)	7.146*** (1.920)	0.143	9 17 363			
	1y growth	0.46 (0.06)	-1.0e-04 (2.5e-04)	0.000	12 21 561	0.81*** (0.06)	9.5e-05 (2.2e-04)	8.240*** (1.639)	0.196	11 18 492			
	3y difference	0.39 (0.08)	0.058 (0.306)	0.000	10 20 400	0.75*** (0.07)	0.411 (0.373)	7.407*** (1.644)	0.128	9 17 363			
	1y difference	0.43 (0.06)	0.107 (0.366)	0.000	12 21 561	0.82*** (0.06)	0.845* (0.470)	8.864*** (1.794)	0.206	11 18 492			
Other investments / GDP		0.48 (0.09)	0.183 (0.289)	0.003	12 21 641	0.80*** (0.05)	0.173 (0.303)	7.891*** (1.444)	0.182	11 18 554			
	3y growth	0.53 (0.08)	6.2e-05 (1.7e-04)	0.000	10 20 400	0.78*** (0.07)	2.3e-03 (1.6e-03)	7.146*** (1.920)	0.143	9 17 363			
	1y growth	0.46 (0.06)	-1.0e-04 (2.5e-04)	0.000	12 21 561	0.81*** (0.06)	9.5e-05 (2.2e-04)	8.240*** (1.639)	0.196	11 18 492			
	3y difference	0.39 (0.08)	0.058 (0.306)	0.000	10 20 400	0.75*** (0.07)	0.411 (0.373)	7.407*** (1.644)	0.128	9 17 363			
	1y difference	0.43 (0.06)	0.107 (0.366)	0.000	12 21 561	0.82*** (0.06)	0.845* (0.470)	8.864*** (1.794)	0.206	11 18 492			

Robust standard errors adjusted for clustering are reported in the parentheses. **, * and *** indicate statistical significance at the 10%, 5% and 1%-level.

Panel E: Measures of potential mispricing of risk, Detken et al. crisis dataset

Indicator	Transformation	univariate				bivariate				Credit-to-GDP gap									
		AUC	Indicator Logit coeff.	pR2	Cr	Co	N	AUC	Indicator Logit coeff.	Logit coeff.	pR2	Cr	Co	N					
Stock market volatility		0.45	(0.05)	-1.962	(1.584)	0.005	26	28	2300	0.83***	(0.03)	-2.632	(2.151)	10.028***	(1.447)	0.181	19	18	1627
	3y growth	0.50	(0.03)	-9.3e-04	(8.9e-04)	0.001	24	28	1983	0.83***	(0.02)	-1.1e-03	(1.6e-03)	9.661***	(1.334)	0.175	19	18	1540
	1y growth	0.53	(0.03)	8.9e-04	(1.1e-03)	0.001	26	28	2195	0.83***	(0.02)	2.6e-03*	(1.5e-03)	9.827***	(1.387)	0.178	19	18	1607
	3y difference	0.51	(0.03)	-0.164	(0.685)	0.000	24	28	1984	0.83***	(0.02)	-0.357	(1.296)	9.638***	(1.321)	0.174	19	18	1540
	1y difference	0.53	(0.02)	0.229	(0.625)	0.000	26	28	2196	0.84***	(0.02)	1.165	(0.899)	9.792***	(1.388)	0.176	19	18	1607
Stock market index	3y growth	0.67***	(0.04)	4.0e-03**	(2.0e-03)	0.014	14	14	971	0.83***	(0.04)	7.8e-03***	(2.6e-03)	10.028***	(1.661)	0.230	14	13	920
	1y growth	0.60***	(0.03)	4.6e-03	(3.0e-03)	0.004	14	14	1075	0.82***	(0.04)	0.010*	(0.005)	9.972***	(1.691)	0.207	14	13	1008
Bank stock index	3y growth	0.62**	(0.05)	3.5e-03*	(2.1e-03)	0.010	16	13	1009	0.79***	(0.04)	7.0e-03***	(2.5e-03)	8.834***	(1.271)	0.177	16	13	1009
	1y growth	0.52	(0.04)	-7.6e-04	(4.3e-03)	0.000	17	13	1111	0.79***	(0.03)	5.0e-03	(4.3e-03)	8.556***	(0.980)	0.156	17	13	1111
Stock market P/E ratio		0.47	(0.05)	-0.023**	(0.011)	0.013	14	23	775	0.78***	(0.05)	-0.052*	(0.030)	7.622***	(1.504)	0.181	12	17	665
	3y growth	0.43	(0.06)	-4.5e-03**	(2.1e-03)	0.032	10	21	529	0.78***	(0.06)	-5.0e-03	(3.2e-03)	7.408***	(1.649)	0.190	10	17	502
	1y growth	0.55*	(0.03)	-3.2e-05	(3.8e-05)	0.000	13	23	695	0.77***	(0.06)	-1.9e-03	(1.2e-03)	7.564***	(1.566)	0.171	11	17	613
	3y difference	0.43	(0.06)	-3.3e-03***	(1.2e-03)	0.020	10	21	529	0.79***	(0.06)	-4.3e-03*	(2.4e-03)	7.733***	(1.712)	0.192	10	17	502
	1y difference	0.55**	(0.02)	-1.8e-04	(1.4e-04)	0.000	13	23	695	0.77***	(0.06)	-2.3e-04	(1.6e-04)	7.599***	(1.573)	0.168	11	17	613
Stock market P/B ratio		0.77**	(0.09)	1.681**	(0.736)	0.148	9	14	173	0.81**	(0.08)	1.540**	(0.647)	6.862**	(2.709)	0.272	9	14	173
	1y growth	0.70***	(0.04)	0.032***	(0.008)	0.111	9	14	117	0.87***	(0.07)	0.047***	(0.011)	8.795***	(2.705)	0.347	9	14	117
	1y difference	0.71***	(0.05)	1.859***	(0.555)	0.123	9	14	117	0.87***	(0.06)	2.897***	(0.577)	9.547***	(3.026)	0.375	9	14	117
Stock market dividend yield		0.44	(0.07)	-0.333	(0.247)	0.016	9	14	381	0.71***	(0.07)	-0.355	(0.227)	6.658***	(1.716)	0.151	9	14	381
	3y growth	0.28***	(0.06)	-0.027***	(0.010)	0.133	9	14	231	0.83***	(0.05)	-0.035***	(0.010)	7.941***	(2.125)	0.301	9	14	231
	1y growth	0.43*	(0.04)	-0.013***	(0.004)	0.025	9	14	333	0.74***	(0.06)	-0.015***	(0.004)	6.672***	(1.694)	0.164	9	14	333
	3y difference	0.28***	(0.05)	-0.877***	(0.326)	0.115	9	14	231	0.82***	(0.05)	-1.136***	(0.361)	7.710***	(2.050)	0.286	9	14	231
	1y difference	0.43*	(0.04)	-0.194***	(0.075)	0.007	9	14	333	0.72**	(0.07)	-0.227***	(0.079)	6.597***	(1.710)	0.146	9	14	333
Household lending spread		0.42	(0.08)	-0.081	(0.226)	0.001	13	27	486	0.73***	(0.08)	-0.342	(0.695)	5.954***	(1.683)	0.140	10	18	359
	3y growth	0.39	(0.09)	-0.012*	(0.007)	0.053	10	19	187	0.83***	(0.08)	-0.018	(0.014)	8.083***	(2.770)	0.265	8	16	167
	1y growth	0.43	(0.05)	-1.7e-03	(2.0e-03)	0.004	13	27	388	0.81***	(0.06)	-0.025	(0.016)	7.705***	(2.025)	0.223	10	18	299
	3y difference	0.37*	(0.08)	-0.586	(0.372)	0.047	10	19	187	0.82***	(0.08)	-0.928	(0.730)	8.244***	(2.748)	0.266	8	16	167
	1y difference	0.44	(0.05)	-0.153	(0.164)	0.003	13	27	388	0.77***	(0.07)	-0.580	(0.568)	7.018***	(1.737)	0.172	10	18	299
Corporate lending spread		0.49	(0.09)	-0.165	(0.367)	0.002	12	26	475	0.73***	(0.07)	-0.417	(0.584)	6.574***	(1.652)	0.148	9	17	348
	3y growth	0.35	(0.09)	-0.032**	(0.014)	0.079	10	19	187	0.82***	(0.09)	-0.039***	(0.014)	7.953***	(2.538)	0.278	8	16	167
	1y growth	0.50	(0.04)	7.7e-04	(5.8e-03)	0.000	12	26	381	0.74***	(0.08)	-0.011	(0.012)	6.920***	(1.763)	0.166	9	17	292
	3y difference	0.31**	(0.08)	-2.505***	(0.816)	0.125	10	19	187	0.83**	(0.09)	-2.752***	(0.960)	7.785***	(2.561)	0.313	8	16	167
	1y difference	0.49	(0.04)	0.027	(0.261)	0.000	12	26	381	0.75**	(0.08)	-0.677	(0.588)	6.872***	(1.710)	0.166	9	17	292
High-yield spread		0.20***	(0.04)	-4.3e-03***	(1.5e-03)	0.143	16	28	1066	0.87***	(0.04)	-5.4e-03**	(2.3e-03)	7.506***	(1.584)	0.317	12	18	623
	3y growth	0.41***	(0.03)	-7.1e-03***	(2.0e-03)	0.049	14	28	770	0.83***	(0.05)	-0.013***	(0.003)	7.726***	(1.613)	0.241	10	18	457
	1y growth	0.45***	(0.02)	-4.4e-03***	(1.3e-03)	0.014	15	28	971	0.76***	(0.05)	-5.1e-03***	(1.6e-03)	7.412***	(1.530)	0.161	11	18	573
	3y difference	0.43***	(0.03)	-4.1e-04**	(1.6e-04)	0.008	14	28	770	0.77***	(0.06)	-8.3e-04***	(3.0e-04)	7.097***	(1.541)	0.165	10	18	457
	1y difference	0.49	(0.03)	-2.5e-04	(1.9e-04)	0.001	15	28	971	0.74***	(0.06)	-1.8e-04	(1.5e-04)	7.090***	(1.538)	0.144	11	18	573
	trend gap	0.56	(0.04)	-1.4e-04	(2.5e-04)	0.000	14	28	591	0.74***	(0.07)	-3.9e-04	(5.2e-04)	6.702***	(1.545)	0.146	10	18	355
	relative gap	0.54	(0.04)	-3.4e-03***	(1.3e-03)	0.012	14	28	591	0.77***	(0.06)	-5.5e-03**	(2.6e-03)	7.085***	(1.541)	0.167	10	18	355
	5y m.a. gap	0.56	(0.04)	-9.6e-05	(2.5e-04)	0.000	14	28	591	0.74***	(0.07)	-3.8e-04	(5.3e-04)	6.713***	(1.559)	0.146	10	18	355
	m.a. gap	0.51	(0.03)	-1.9e-03***	(4.6e-04)	0.031	14	28	591	0.79***	(0.06)	-3.0e-03***	(9.6e-04)	7.364***	(1.648)	0.198	10	18	355
	CBOE Volatility Index		0.29***	(0.03)	-0.123***	(0.029)	0.071	29	28	2232	0.82***	(0.03)	-0.116***	(0.028)	9.610***	(1.770)	0.224	18	18
3y growth		0.32***	(0.05)	-0.013**	(0.006)	0.045	27	28	1908	0.81***	(0.05)	-0.015*	(0.009)	8.140***	(1.361)	0.204	16	18	1027
1y growth		0.45	(0.03)	-5.6e-03	(3.8e-03)	0.003	29	28	2124	0.80***	(0.03)	-7.5e-03	(6.1e-03)	8.559***	(1.301)	0.162	18	18	1131
3y difference		0.33***	(0.05)	-0.070***	(0.022)	0.057	27	28	1908	0.82***	(0.05)	-0.085***	(0.031)	8.186***	(1.375)	0.228	16	18	1027
1y difference		0.45	(0.03)	-0.016	(0.013)	0.002	29	28	2124	0.80***	(0.03)	-0.025	(0.023)	8.520***	(1.290)	0.159	18	18	1131
trend gap		0.31***	(0.05)	-0.108***	(0.034)	0.068	25	28	1737	0.82***	(0.06)	-0.124***	(0.045)	7.495***	(1.278)	0.236	15	18	953
relative gap		0.31***	(0.06)	-0.020***	(0.008)	0.061	25	28	1737	0.81***	(0.06)	-0.023**	(0.011)	7.322***	(1.230)	0.222	15	18	953
5y m.a. gap		0.35***	(0.05)	-0.084***	(0.031)	0.037	25	28	1737	0.81***	(0.05)	-0.099**	(0.044)	7.974***	(1.268)	0.202	15	18	953
m.a. gap		0.26***	(0.04)	-0.134***	(0.040)	0.086	25	28	1737	0.85***	(0.05)	-0.163***	(0.057)	9.043***	(1.802)	0.268	15	18	953

continues on next page...

German 10y Bund		0.32*** (0.04)	-0.361*** (0.080)	0.055 32 28 4060	0.83*** (0.03)	-0.070 (0.155)	9.299*** (1.606)	0.168 20 18 1803
3y growth		0.50 (0.03)	-3.9e-03 (3.7e-03)	0.001 31 28 3724	0.83*** (0.03)	-6.4e-04 (6.2e-03)	9.869*** (1.640)	0.167 20 18 1803
1y growth		0.54 (0.03)	6.8e-03 (5.7e-03)	0.001 32 28 3948	0.80*** (0.03)	0.017** (0.008)	10.041*** (1.785)	0.175 20 18 1803
3y difference		0.52 (0.03)	-3.3e-03 (4.7e-02)	0.000 31 28 3724	0.82*** (0.03)	0.038 (0.093)	9.868*** (1.658)	0.167 20 18 1803
1y difference		0.53 (0.03)	0.047 (0.083)	0.000 32 28 3948	0.81*** (0.04)	0.187 (0.147)	9.904*** (1.716)	0.170 20 18 1803
trend gap		0.57** (0.03)	0.119 (0.088)	0.002 31 28 3535	0.82*** (0.03)	0.089 (0.182)	9.858*** (1.668)	0.168 20 18 1803
relative gap		0.56* (0.03)	9.8e-03 (6.5e-03)	0.003 31 28 3535	0.82*** (0.03)	9.0e-03 (1.1e-02)	9.889*** (1.687)	0.169 20 18 1803
5y m.a. gap		0.56* (0.03)	0.074 (0.079)	0.001 31 28 3535	0.82*** (0.03)	0.109 (0.143)	9.868*** (1.665)	0.168 20 18 1803
m.a. gap		0.38*** (0.04)	-0.324*** (0.114)	0.024 31 28 3535	0.83*** (0.03)	-0.057 (0.183)	9.563*** (1.590)	0.167 20 18 1803
German 1y bill		0.44 (0.04)	-0.077 (0.079)	0.003 30 28 2747	0.80*** (0.03)	0.112 (0.119)	9.914*** (1.458)	0.167 19 18 1432
3y growth		0.59* (0.05)	5.8e-03** (2.7e-03)	0.016 30 28 2423	0.81*** (0.02)	9.4e-03*** (2.6e-03)	8.700*** (1.328)	0.193 19 18 1276
1y growth		0.64** (0.05)	0.017*** (0.005)	0.035 30 28 2639	0.84*** (0.02)	0.027*** (0.004)	9.255*** (1.489)	0.239 19 18 1380
3y difference		0.57 (0.05)	0.089 (0.068)	0.007 30 28 2423	0.81*** (0.02)	0.231*** (0.071)	8.765*** (1.256)	0.194 19 18 1276
1y difference		0.63** (0.05)	0.286** (0.125)	0.020 30 28 2639	0.83*** (0.03)	0.627*** (0.107)	9.419*** (1.459)	0.229 19 18 1380
trend gap		0.55 (0.06)	0.109 (0.124)	0.005 29 28 2232	0.80*** (0.04)	0.405*** (0.143)	8.927*** (1.421)	0.204 18 18 1183
relative gap		0.59 (0.06)	9.8e-03* (5.4e-03)	0.020 29 28 2232	0.82*** (0.04)	0.019*** (0.005)	8.774*** (1.499)	0.219 18 18 1183
5y m.a. gap		0.57 (0.06)	0.142 (0.114)	0.008 29 28 2232	0.81*** (0.03)	0.459*** (0.107)	9.047*** (1.438)	0.214 18 18 1183
m.a. gap		0.53 (0.04)	0.027 (0.084)	0.000 29 28 2232	0.79*** (0.04)	0.223* (0.118)	9.529*** (1.460)	0.180 18 18 1183
German 1m bill		0.40*** (0.04)	-0.135* (0.070)	0.013 30 28 3179	0.83*** (0.02)	9.5e-03 (1.1e-01)	9.957*** (1.457)	0.174 19 18 1640
3y growth		0.55 (0.05)	7.0e-04 (1.6e-03)	0.000 30 28 2855	0.81*** (0.02)	3.0e-03* (1.8e-03)	9.435*** (1.293)	0.169 19 18 1484
1y growth		0.60** (0.04)	6.0e-03** (2.8e-03)	0.007 30 28 3071	0.83*** (0.02)	0.014*** (0.002)	10.325*** (1.571)	0.207 19 18 1588
3y difference		0.54 (0.05)	0.015 (0.044)	0.000 30 28 2855	0.81*** (0.03)	0.081 (0.057)	9.352*** (1.272)	0.171 19 18 1484
1y difference		0.57* (0.04)	0.091 (0.061)	0.003 30 28 3071	0.82*** (0.02)	0.318*** (0.056)	10.378*** (1.535)	0.201 19 18 1588
trend gap		0.61* (0.05)	0.216** (0.095)	0.023 30 28 2666	0.80*** (0.03)	0.331** (0.132)	8.565*** (1.216)	0.194 19 18 1393
relative gap		0.63** (0.05)	0.013*** (0.005)	0.036 30 28 2666	0.81*** (0.03)	0.016*** (0.005)	8.541*** (1.355)	0.204 19 18 1393
5y m.a. gap		0.60** (0.05)	0.196** (0.099)	0.016 30 28 2666	0.81*** (0.03)	0.396*** (0.119)	8.861*** (1.262)	0.203 19 18 1393
m.a. gap		0.51 (0.04)	0.031 (0.091)	0.000 30 28 2666	0.80*** (0.03)	0.181 (0.133)	9.681*** (1.335)	0.171 19 18 1393
US 10y T-note		0.33*** (0.03)	-0.273*** (0.062)	0.046 32 28 4060	0.83*** (0.03)	-0.016 (0.079)	9.681*** (1.852)	0.167 20 18 1803
3y growth		0.55 (0.03)	3.1e-03 (3.7e-03)	0.001 31 28 3724	0.81*** (0.03)	0.014*** (0.005)	10.576*** (1.845)	0.181 20 18 1803
1y growth		0.50 (0.02)	9.7e-04 (3.9e-03)	0.000 32 28 3948	0.81*** (0.03)	0.012** (0.006)	10.104*** (1.768)	0.172 20 18 1803
3y difference		0.54 (0.03)	-7.3e-03 (3.9e-02)	0.000 31 28 3724	0.82*** (0.03)	0.069 (0.060)	10.026*** (1.658)	0.169 20 18 1803
1y difference		0.48 (0.02)	-9.6e-03 (3.8e-02)	0.000 32 28 3948	0.82*** (0.03)	0.106 (0.078)	9.981*** (1.714)	0.169 20 18 1803
trend gap		0.55 (0.05)	0.065 (0.074)	0.001 31 28 3535	0.83*** (0.03)	7.5e-05 (1.3e-01)	9.875*** (1.740)	0.167 20 18 1803
relative gap		0.57 (0.05)	0.020** (0.009)	0.015 31 28 3535	0.80*** (0.03)	0.020 (0.013)	9.448*** (1.797)	0.180 20 18 1803
5y m.a. gap		0.54 (0.03)	-5.9e-04 (5.3e-02)	0.000 31 28 3535	0.82*** (0.03)	0.127 (0.084)	10.066*** (1.699)	0.170 20 18 1803
m.a. gap		0.34*** (0.03)	-0.297*** (0.060)	0.053 31 28 3535	0.83*** (0.03)	-0.037 (0.081)	9.496*** (1.622)	0.168 20 18 1803
US 1y T-bill		0.43* (0.03)	-0.067* (0.041)	0.005 30 28 2747	0.80*** (0.03)	0.131** (0.051)	10.714*** (1.642)	0.178 19 18 1432
3y growth		0.72*** (0.05)	8.0e-03*** (1.4e-03)	0.116 30 28 2423	0.85*** (0.03)	8.9e-03*** (1.8e-03)	8.906*** (1.603)	0.284 19 18 1276
1y growth		0.61*** (0.03)	6.4e-03*** (2.2e-03)	0.011 30 28 2639	0.82*** (0.03)	7.7e-03** (3.0e-03)	8.985*** (1.248)	0.174 19 18 1380
3y difference		0.71*** (0.05)	0.298*** (0.087)	0.086 30 28 2423	0.83*** (0.05)	0.361*** (0.109)	9.189*** (1.681)	0.264 19 18 1276
1y difference		0.61*** (0.03)	0.209*** (0.060)	0.019 30 28 2639	0.80*** (0.04)	0.309*** (0.116)	9.243*** (1.379)	0.190 19 18 1380
trend gap		0.67*** (0.05)	0.405** (0.166)	0.044 29 28 2232	0.85*** (0.05)	0.745*** (0.255)	10.470*** (2.144)	0.273 18 18 1183
relative gap		0.70*** (0.05)	0.020*** (0.006)	0.088 29 28 2232	0.85*** (0.05)	0.026*** (0.007)	9.553*** (1.978)	0.298 18 18 1183
5y m.a. gap		0.69*** (0.05)	0.424*** (0.141)	0.066 29 28 2232	0.84*** (0.05)	0.588*** (0.191)	9.527*** (1.876)	0.266 18 18 1183
m.a. gap		0.63** (0.05)	0.292** (0.132)	0.028 29 28 2232	0.85*** (0.04)	0.669*** (0.178)	10.746*** (1.972)	0.267 18 18 1183
US 1m T-bill		0.38*** (0.03)	-0.114*** (0.032)	0.021 30 28 3179	0.82*** (0.03)	0.045 (0.035)	10.575*** (1.573)	0.177 19 18 1640
3y growth		0.71*** (0.05)	7.3e-03*** (1.2e-03)	0.120 30 28 2855	0.85*** (0.04)	7.7e-03*** (1.6e-03)	9.361*** (1.778)	0.283 19 18 1484
1y growth		0.62*** (0.04)	7.9e-03*** (2.3e-03)	0.019 30 28 3071	0.83*** (0.03)	9.4e-03*** (3.0e-03)	9.865*** (1.543)	0.199 19 18 1588
3y difference		0.68*** (0.05)	0.144*** (0.039)	0.040 30 28 2855	0.81*** (0.04)	0.190*** (0.056)	9.846*** (1.634)	0.219 19 18 1484
1y difference		0.61*** (0.03)	0.093*** (0.028)	0.008 30 28 3071	0.82*** (0.03)	0.170*** (0.054)	10.142*** (1.525)	0.190 19 18 1588
trend gap		0.72*** (0.04)	0.458*** (0.127)	0.088 30 28 2666	0.83*** (0.05)	0.516*** (0.183)	8.880*** (1.536)	0.250 19 18 1393
relative gap		0.72*** (0.05)	0.017*** (0.003)	0.118 30 28 2666	0.85*** (0.04)	0.018*** (0.004)	8.866*** (1.796)	0.287 19 18 1393
5y m.a. gap		0.72*** (0.05)	0.471*** (0.125)	0.097 30 28 2666	0.83*** (0.05)	0.537*** (0.168)	9.279*** (1.756)	0.269 19 18 1393
m.a. gap		0.63*** (0.05)	0.278** (0.131)	0.026 30 28 2666	0.83*** (0.04)	0.589*** (0.147)	10.926*** (1.906)	0.253 19 18 1393

Robust standard errors adjusted for clustering are reported in the parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1%-level.

Panel F: Measures of the strength of bank balance sheets, Detken et al. crisis dataset

Indicator	Transformation	univariate					bivariate												
		AUC	Indicator Logit coeff.	pR2	Cr	Co N	AUC	Indicator Logit coeff.	Indicator Logit coeff.	pR2	Cr	Co N							
Leverage ratio		0.38	(0.08)	-0.179	(0.124)	0.027	14	26	719	0.74**	(0.07)	-0.170	(0.186)	6.197***	(1.568)	0.142	12	18	563
	3y growth	0.33**	(0.08)	-0.044*	(0.024)	0.057	12	25	444	0.71**	(0.06)	-0.024	(0.022)	5.592***	(1.930)	0.132	10	18	380
	1y growth	0.41*	(0.05)	-0.032	(0.023)	0.015	13	26	628	0.71***	(0.06)	-7.6e-03	(2.4e-02)	6.405***	(1.679)	0.124	11	18	504
	3y difference	0.34**	(0.07)	-0.380	(0.235)	0.034	12	25	444	0.70**	(0.07)	-0.185	(0.236)	5.828***	(1.797)	0.123	10	18	380
	1y difference	0.41*	(0.05)	-0.357	(0.220)	0.012	13	26	628	0.71***	(0.06)	-0.086	(0.298)	6.426***	(1.634)	0.124	11	18	504
Loans / deposits		0.67*	(0.07)	0.011***	(0.003)	0.063	12	26	537	0.75***	(0.06)	7.0e-03	(4.9e-03)	5.903***	(1.437)	0.166	10	18	405
	3y growth	0.52	(0.10)	1.1e-03	(1.7e-02)	0.000	11	23	245	0.78**	(0.08)	-0.023	(0.022)	7.147***	(2.204)	0.176	9	17	214
	1y growth	0.55	(0.07)	0.018	(0.030)	0.004	12	26	446	0.75***	(0.07)	-0.034	(0.048)	7.009***	(1.594)	0.157	10	18	347
	3y difference	0.58	(0.10)	0.020	(0.016)	0.024	11	23	245	0.74**	(0.10)	2.7e-04	(2.2e-02)	6.545***	(2.328)	0.157	9	17	214
	1y difference	0.59	(0.07)	0.039	(0.027)	0.020	12	26	446	0.74***	(0.07)	-7.7e-03	(3.8e-02)	6.845***	(1.651)	0.150	10	18	347
Total assets / GDP		0.56	(0.08)	-0.037	(0.041)	0.007	14	21	759	0.73***	(0.05)	-0.047	(0.051)	7.210***	(1.437)	0.137	13	18	654
	3y growth	0.67**	(0.07)	0.029**	(0.012)	0.045	12	20	526	0.72***	(0.06)	4.9e-03	(1.8e-02)	6.246***	(2.036)	0.130	11	18	489
	1y growth	0.69***	(0.05)	0.067***	(0.022)	0.041	13	21	678	0.74***	(0.05)	0.027	(0.029)	6.327***	(1.552)	0.137	12	18	597
	3y difference	0.59	(0.08)	0.095	(0.280)	0.002	12	20	526	0.72***	(0.07)	-0.197	(0.285)	7.063***	(1.966)	0.133	11	18	489
	1y difference	0.65***	(0.05)	0.240	(0.370)	0.003	13	21	678	0.73***	(0.06)	-0.129	(0.373)	6.906***	(1.594)	0.132	12	18	597
Non-core liabilities / GDP		0.48	(0.11)	-0.074	(0.060)	0.017	10	20	422	0.74***	(0.07)	-0.167	(0.157)	7.554***	(2.005)	0.172	9	17	373
	3y growth	0.51	(0.12)	1.1e-03	(1.4e-02)	0.000	8	17	206	0.81***	(0.08)	-0.033*	(0.019)	8.772***	(3.071)	0.233	8	16	194
	1y growth	0.60	(0.08)	0.018	(0.022)	0.007	10	20	352	0.74***	(0.07)	-0.013	(0.026)	6.865***	(1.827)	0.160	9	17	319
	3y difference	0.52	(0.14)	-0.130	(0.330)	0.004	8	17	206	0.78**	(0.09)	-0.668*	(0.390)	8.146***	(2.381)	0.211	8	16	194
	1y difference	0.55	(0.09)	-0.017	(0.259)	0.000	10	20	352	0.75***	(0.07)	-0.495***	(0.155)	7.281***	(1.747)	0.170	9	17	319
Non-core liabilities / Total assets		0.57	(0.09)	1.320	(2.191)	0.007	11	25	496	0.73***	(0.07)	0.065	(2.513)	6.612***	(1.958)	0.150	9	17	373
	3y growth	0.47	(0.10)	5.2e-05	(2.2e-02)	0.000	9	21	223	0.81***	(0.08)	-0.058**	(0.029)	6.874***	(2.265)	0.225	8	16	194
	1y growth	0.52	(0.07)	0.016	(0.028)	0.004	11	25	409	0.75***	(0.08)	-0.040	(0.039)	6.634***	(1.617)	0.167	9	17	319
	3y difference	0.50	(0.11)	2.743	(6.354)	0.004	9	21	223	0.80***	(0.09)	-11.742	(9.382)	7.062***	(2.350)	0.201	8	16	194
	1y difference	0.53	(0.06)	7.120	(6.780)	0.009	11	25	409	0.75***	(0.07)	-6.395	(11.082)	6.698***	(1.642)	0.161	9	17	319
Foreign currency cross border loans / GDP		0.57	(0.09)	-1.533**	(0.737)	0.017	12	15	874	0.76***	(0.04)	-6.100	(8.496)	8.161***	(1.455)	0.148	11	12	796
	3y growth	0.45	(0.07)	-3.4e-03	(2.8e-03)	0.014	11	14	680	0.77***	(0.05)	-6.2e-03**	(3.0e-03)	7.091***	(1.209)	0.159	10	12	646
	1y growth	0.50	(0.06)	-2.5e-03	(3.7e-03)	0.002	12	15	788	0.75***	(0.04)	-1.8e-03	(3.1e-03)	6.788***	(0.961)	0.127	11	12	726
	3y difference	0.58	(0.08)	-0.800	(0.487)	0.001	12	14	711	0.75***	(0.04)	-6.344	(4.831)	6.918***	(0.866)	0.130	11	12	677
	1y difference	0.55	(0.06)	-1.495*	(0.802)	0.001	12	15	819	0.75***	(0.04)	-6.178	(5.531)	7.087***	(0.927)	0.131	11	12	757
	trend gap	0.64**	(0.07)	3.014**	(1.493)	0.004	11	12	629	0.75***	(0.05)	-4.735	(7.652)	6.587***	(0.874)	0.127	11	12	607
	relative gap	0.58	(0.08)	2.7e-03	(2.7e-03)	0.004	11	12	617	0.75***	(0.05)	-8.9e-04	(4.5e-03)	6.487***	(1.035)	0.124	11	12	595
	5y m.a. gap	0.60	(0.08)	-0.246	(0.986)	0.000	11	12	629	0.75***	(0.05)	-9.830	(8.432)	6.792***	(0.825)	0.133	11	12	607
	m.a. gap	0.62	(0.08)	-1.127	(2.209)	0.001	11	12	629	0.75***	(0.05)	-4.975	(6.639)	6.691***	(0.845)	0.130	11	12	607
	Own currency cross border loans / GDP	0.56	(0.09)	-1.979**	(0.999)	0.016	12	15	874	0.76***	(0.04)	-8.338	(9.263)	8.313***	(1.514)	0.150	11	12	796
3y growth	0.43	(0.07)	-4.5e-03	(3.1e-03)	0.022	11	14	680	0.78***	(0.06)	-8.6e-03**	(3.5e-03)	7.472***	(1.279)	0.178	10	12	646	
1y growth	0.51	(0.05)	-2.4e-03	(3.2e-03)	0.003	12	15	788	0.76***	(0.05)	-2.0e-03	(2.6e-03)	6.801***	(0.956)	0.128	11	12	726	
3y difference	0.54	(0.08)	-2.424***	(0.773)	0.004	12	14	711	0.75***	(0.04)	-12.808	(12.897)	7.138***	(0.881)	0.137	11	12	677	
1y difference	0.53	(0.06)	-3.127***	(1.094)	0.002	12	15	819	0.75***	(0.04)	-10.389*	(5.357)	7.216***	(0.928)	0.134	11	12	757	
trend gap	0.57	(0.07)	0.311	(1.231)	0.000	11	12	629	0.75***	(0.05)	-8.419	(8.226)	6.650***	(0.836)	0.130	11	12	607	
relative gap	0.55	(0.09)	2.2e-03	(2.9e-03)	0.003	11	12	617	0.75***	(0.04)	-9.9e-04	(5.1e-03)	6.485***	(1.034)	0.124	11	12	595	
5y m.a. gap	0.57	(0.08)	-2.682**	(1.342)	0.002	11	12	629	0.76***	(0.04)	-13.298	(9.599)	6.902***	(0.821)	0.137	11	12	607	
m.a. gap	0.59	(0.08)	-2.841	(2.664)	0.003	11	12	629	0.75***	(0.05)	-8.527	(7.013)	6.997***	(0.885)	0.137	11	12	607	
Foreign currency cross border loans / Assets		0.41	(0.11)	-39.573*	(22.101)	0.044	10	17	582	0.74***	(0.08)	-45.690	(35.324)	6.658***	(1.803)	0.155	9	12	467
	3y growth	0.52	(0.10)	-5.9e-04	(2.7e-03)	0.000	8	16	395	0.71**	(0.09)	-2.0e-03	(3.0e-03)	6.449***	(2.108)	0.145	7	12	348
	1y growth	0.49	(0.07)	-3.1e-03	(5.2e-03)	0.002	9	17	515	0.70**	(0.07)	5.2e-03	(6.7e-03)	6.431***	(1.801)	0.132	8	12	424
	3y difference	0.53	(0.09)	10.190	(21.678)	0.001	8	16	395	0.73**	(0.08)	38.758	(32.893)	6.897***	(2.192)	0.152	7	12	348
	1y difference	0.51	(0.06)	19.535	(31.326)	0.001	9	17	515	0.73**	(0.07)	110.763*	(58.992)	6.803***	(1.800)	0.146	8	12	424
Own currency cross border loans / Assets		0.41	(0.10)	-50.117*	(27.027)	0.039	10	17	582	0.74***	(0.08)	-60.905	(40.316)	6.840***	(1.861)	0.157	9	12	467
	3y growth	0.49	(0.10)	-1.2e-03	(3.7e-03)	0.001	8	16	395	0.71*	(0.10)	-4.1e-03	(3.5e-03)	6.385***	(2.017)	0.151	7	12	348
	1y growth	0.48	(0.07)	-3.3e-03	(4.6e-03)	0.003	9	17	515	0.70**	(0.08)	2.4e-04	(3.3e-03)	6.260***	(1.822)	0.129	8	12	424
	3y difference	0.49	(0.09)	-17.398	(34.903)	0.002	8	16	395	0.70*	(0.10)	-1.321	(27.633)	6.474***	(2.104)	0.142	7	12	348
	1y difference	0.48	(0.07)	-2.436	(29.175)	0.000	9	17	515	0.70**	(0.08)	22.502	(28.434)	6.334***	(1.815)	0.130	8	12	424
(ST liabilities - Liquid assets) / Total assets		0.74*	(0.10)	6.896**	(3.478)	0.119	6	13	297	0.83**	(0.09)	7.131	(6.025)	6.004**	(2.822)	0.236	6	12	264
	3y growth	0.66**	(0.09)	-3.5e-04	(2.3e-04)	0.011	6	13	151	0.74	(0.13)	-4.2e-04	(2.8e-04)	5.817***	(2.016)	0.171	6	12	142
	1y growth	0.68**	(0.08)	0.015**	(0.006)	0.073	6	13	253	0.83***	(0.07)	0.037***	(0.009)	7.619***	(2.052)	0.293	6	12	228
	3y difference	0.79***	(0.09)	24.154**	(10.245)	0.200	6	13	151	0.92***	(0.05)	34.420***	(10.960)	7.723***	(2.634)	0.447	6	12	142
	1y difference	0.68**	(0.08)	11.673	(11.131)	0.032	6	13	253	0.82***	(0.07)	24.771**	(10.186)	6.496***	(1.879)	0.250	6	12	228
Short-term liabilities / Liquid assets		0.77**	(0.10)	1.994**	(0.847)	0.165	6	13	297	0.82***	(0.09)	1.727	(1.065)	5.082*	(2.645)	0.246	6	12	264
	3y growth	0.84**	(0.10)	0.117**	(0.055)	0.286	6	13	151	0.92***	(0.05)	0.125***	(0.045)	6.443**	(3.202)	0.444	6	12	142
	1y growth	0.66	(0.08)	0.049	(0.035)	0.035	6	13	253	0.79***	(0.08)	0.069**</							

Table B2. All early-warning evaluation results for each indicator category with ESCB Heads of Research banking crisis dataset. Evaluation horizon is 1 to 3 years. Statistical significance and larger |AUC-0.5| indicates better performance. pR2 is pseudo R2, Cr is the number of crises, Co is the number of countries, N is the number of observations.

Panel A: Measures of credit developments, ESCB Heads of Research crisis dataset

Indicator	Transformation	univariate				bivariate				Credit-to-GDP gap									
		AUC	Indicator Logit coeff.	pR2	Cr	Co	N	AUC	Indicator Logit coeff.	Logit coeff.	pR2	Cr	Co	N					
Total credit (real)	3y growth	0.46	(0.06)	-3.5e-03	-0.01	0.001	17	15	1138	0.73***	(0.06)	-0.036**	(0.015)	6.736***	(2.035)	0.061	15	14	1110
	1y growth	0.51	(0.05)	0.0044	-0.016	0.000	17	15	1226	0.67***	(0.06)	-0.029	(0.026)	4.451**	(1.760)	0.034	15	14	1158
	relative gap	0.45	(0.07)	-0.015	(0.020)	0.003	14	14	1074	0.72***	(0.05)	-0.059***	(0.023)	6.734***	(2.127)	0.064	14	14	1074
Total bank credit (real)	3y growth	0.50	(0.06)	0.0019	-0.0074	0.000	16	15	1125	0.69**	(0.07)	-9.8e-03	-0.0082	5.104**	(2.037)	0.043	14	14	1104
	1y growth	0.56	(0.05)	0.013	(0.013)	0.003	17	15	1207	0.64*	(0.06)	0.002	-0.014	4.044**	(1.669)	0.033	15	14	1154
	relative gap	0.50	(0.07)	-1.8e-03	-0.013	0.000	13	14	1068	0.69***	(0.07)	-0.017	(0.013)	5.033**	(2.018)	0.044	13	14	1068
Household credit (real)	3y growth	0.56	(0.06)	0.0025	-0.0063	0.001	14	14	848	0.60	(0.07)	-1.0e-03	-0.0058	3.071*	(1.652)	0.020	14	14	841
	1y growth	0.56	(0.06)	0.000084	-0.015	0.000	16	15	932	0.61	(0.06)	-3.1e-03	-0.015	3.339**	(1.664)	0.024	14	14	905
	relative gap	0.49	(0.09)	-0.012	(0.022)	0.003	12	13	791	0.62**	(0.06)	-0.018	(0.022)	2.605	(1.788)	0.017	12	13	791
Corporate credit (real)	3y growth	0.38	(0.07)	-0.022	(0.017)	0.017	14	14	848	0.74***	(0.05)	-0.061***	(0.013)	7.702***	(1.854)	0.088	14	14	841
	1y growth	0.52	(0.05)	0.0058	-0.017	0.000	16	15	932	0.62*	(0.06)	-0.014	(0.020)	3.555**	(1.642)	0.025	14	14	905
	relative gap	0.30***	(0.06)	-0.091**	(0.044)	0.064	12	13	791	0.79***	(0.04)	-0.155***	(0.037)	7.986***	(2.286)	0.140	12	13	791
Total credit / GDP		0.66***	(0.05)	1.083***	(0.248)	0.067	27	18	2032	0.70***	(0.04)	0.769*	(0.450)	3.132	(2.302)	0.070	24	17	1726
	3y growth	0.55	(0.06)	0.0043	-0.0088	0.001	27	18	1832	0.69***	(0.05)	-2.0e-03	-0.011	5.760***	(1.165)	0.054	24	17	1726
	1y growth	0.57	(0.05)	0.026	(0.026)	0.005	27	18	1968	0.69***	(0.05)	0.013	(0.031)	5.461***	(1.178)	0.055	24	17	1726
	3y difference	0.66***	(0.05)	3.786***	(0.815)	0.049	27	18	1832	0.68***	(0.05)	-3.784	(3.599)	10.438**	(4.934)	0.058	24	17	1726
	1y difference	0.65***	(0.05)	9.016***	(2.138)	0.054	27	18	1968	0.69***	(0.05)	5.545*	(3.259)	2.968	(2.114)	0.058	24	17	1726
	trend gap	0.70***	(0.05)	5.667***	(1.211)	0.054	24	17	1726	0.70***	(0.05)	5.667***	(1.211)	0	(.)	0.054	24	17	1726
	relative gap	0.65**	(0.05)	0.046**	(0.019)	0.037	24	17	1726	0.69***	(0.05)	0.018	(0.024)	4.478***	(1.630)	0.056	24	17	1726
	5y m.a. gap	0.67***	(0.04)	6.081***	(1.383)	0.045	24	17	1726	0.70***	(0.05)	-1.576	(4.585)	6.947*	(4.187)	0.054	24	17	1726
	m.a. gap	0.68***	(0.04)	1.839***	(0.289)	0.072	24	17	1726	0.70***	(0.04)	1.470**	(0.731)	1.726	(2.775)	0.074	24	17	1726
	1y diff. / 5y m.a.	0.66***	(0.05)	10.270***	(1.900)	0.091	27	18	1972	0.68***	(0.05)	11.814***	(2.863)	0.0017	(-1.99)	0.097	24	17	1726
	Total bank credit / GDP		0.66***	(0.05)	1.861***	(0.488)	0.063	27	18	2000	0.70***	(0.04)	1.455**	(0.703)	2.798	(2.040)	0.077	24	17
3y growth		0.54	(0.06)	0.0063	-0.0096	0.003	26	18	1806	0.70***	(0.04)	0.001	-0.011	5.794***	(1.228)	0.058	23	17	1714
1y growth		0.58	(0.05)	0.034	(0.026)	0.009	27	18	1936	0.68***	(0.04)	0.028	(0.030)	5.390***	(1.192)	0.061	24	17	1722
3y difference		0.67***	(0.05)	6.927***	(1.543)	0.065	26	18	1806	0.68***	(0.05)	5.609*	(3.151)	1.417	(2.887)	0.069	23	17	1714
1y difference		0.66***	(0.05)	19.420***	(3.901)	0.087	27	18	1936	0.67***	(0.05)	21.438***	(6.521)	-0.611	(2.544)	0.099	24	17	1722
trend gap		0.67**	(0.05)	8.101***	(1.828)	0.064	23	17	1707	0.68***	(0.05)	5.769	(4.089)	1.987	(2.888)	0.065	23	17	1707
relative gap		0.63**	(0.05)	0.040***	(0.015)	0.038	23	17	1707	0.69***	(0.05)	0.016	(0.019)	4.680***	(1.596)	0.061	23	17	1707
5y m.a. gap		0.68***	(0.05)	11.691***	(2.355)	0.080	23	17	1707	0.68***	(0.05)	12.338**	(5.515)	-0.429	(3.216)	0.080	23	17	1707
m.a. gap		0.70***	(0.04)	3.205***	(0.585)	0.086	23	17	1707	0.71***	(0.04)	2.798***	(1.080)	1.197	(2.363)	0.087	23	17	1707
1y diff. / 5y m.a.		0.68***	(0.06)	18.452***	(4.180)	0.114	27	18	1940	0.69***	(0.06)	19.367***	(5.142)	-0.186	(2.150)	0.126	24	17	1722
Total household credit / GDP			0.67***	(0.06)	2.307***	(0.712)	0.060	23	18	1386	0.73***	(0.04)	2.216***	(0.732)	2.835	(1.738)	0.097	20	17
	3y growth	0.56	(0.06)	0.0008	-0.0036	0.000	21	17	1207	0.67**	(0.06)	-6.7e-04	-0.0048	4.853***	(1.459)	0.046	20	17	1181
	1y growth	0.55	(0.05)	-4.2e-03	-0.011	0.000	23	18	1330	0.69***	(0.06)	-8.7e-03	-0.019	5.390***	(1.466)	0.055	20	17	1252
	3y difference	0.72***	(0.06)	12.924***	(2.503)	0.111	21	17	1207	0.74***	(0.05)	17.506***	(4.751)	-3.144	(2.782)	0.125	20	17	1181
	1y difference	0.68***	(0.06)	27.582***	(7.126)	0.082	23	18	1330	0.72***	(0.06)	32.537***	(10.982)	-0.293	(2.394)	0.107	20	17	1252
	trend gap	0.70***	(0.06)	14.690***	(3.919)	0.066	19	16	1115	0.69***	(0.05)	18.918**	(8.225)	-2.034	(3.482)	0.068	19	16	1115
	relative gap	0.61	(0.06)	0.022	(0.016)	0.012	19	16	1115	0.65**	(0.06)	0.0056	-0.018	3.939**	(1.648)	0.035	19	16	1115
	5y m.a. gap	0.72***	(0.05)	19.661***	(4.166)	0.099	19	16	1115	0.72***	(0.06)	27.332***	(7.943)	-3.595	(2.699)	0.107	19	16	1115
	m.a. gap	0.71***	(0.05)	4.353***	(0.912)	0.068	19	16	1115	0.72***	(0.05)	3.906***	(1.264)	1.003	(2.043)	0.069	19	16	1115
	1y diff. / 5y m.a.	0.70***	(0.07)	28.504***	(5.937)	0.127	23	18	1330	0.74***	(0.06)	33.338***	(6.930)	-0.448	(2.130)	0.161	20	17	1252
	Total corporate credit / GDP		0.65***	(0.06)	1.573***	(0.444)	0.060	22	18	1373	0.71***	(0.06)	0.797	(0.785)	3.896	(2.495)	0.062	20	17
3y growth		0.52	(0.06)	0.0046	-0.01	0.002	20	17	1198	0.67**	(0.06)	-5.9e-03	-0.017	5.204***	(1.780)	0.046	20	17	1173
1y growth		0.56	(0.05)	0.031	(0.023)	0.009	22	18	1321	0.67***	(0.05)	0.016	(0.031)	4.957***	(1.578)	0.056	20	17	1252
3y difference		0.52	(0.06)	0.880	(1.976)	0.001	20	17	1198	0.71***	(0.06)	-13.445***	(4.402)	15.184***	(3.658)	0.113	20	17	1173
1y difference		0.60*	(0.05)	6.868**	(3.117)	0.021	22	18	1321	0.68***	(0.05)	-4.154	(3.126)	6.598***	(1.982)	0.057	20	17	1252
trend gap		0.54	(0.07)	1.633	(2.767)	0.002	19	16	1100	0.72***	(0.05)	-21.392***	(4.516)	16.595***	(3.858)	0.104	19	16	1100
relative gap		0.55	(0.06)	0.031	(0.023)	0.011	19	16	1100	0.66***	(0.05)	-0.033	(0.042)	6.229**	(3.073)	0.038	19	16	1100
5y m.a. gap		0.54	(0.06)	2.003	(2.995)	0.003	19	16	1100	0.68**	(0.06)	-15.521***	(5.473)	12.230***	(3.265)	0.074	19	16	1100
m.a. gap		0.63*	(0.06)	1.670**	(0.669)	0.019	19	16	1100	0.67***	(0.05)	0.401	(1.339)	3.632	(2.847)	0.034	19	16	1100
1y diff. / 5y m.a.		0.64***	(0.05)	12.146***	(3.402)	0.057	22	18	1321	0.68***	(0.05)	7.965**	(3.298)	3.103*	(1.688)	0.066	20	17	1252

Robust standard errors adjusted for clustering are reported in the parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1%-level.

Panel B: Measures of private sector debt burden, ESCB Heads of Research crisis dataset

Indicator	Transformation	univariate						bivariate				Credit-to-GDP gap							
		AUC	Indicator Logit coeff.	pR2	Cr	Co	N	AUC	Indicator Logit coeff.	Logit coeff.	pR2	Cr	Co	N					
Household credit / Gross disposable income		0.59	(0.05)	1.0e-04	(7.1e-05)	0.001	17	11	1047	0.70***	(0.06)	5.5e-05	(7.7e-05)	5.629***	(1.446)	0.066	17	11	1045
	3y growth	0.72**	(0.06)	0.063***	(0.016)	0.099	15	11	949	0.73***	(0.05)	0.050***	(0.019)	3.387**	(1.602)	0.116	15	11	949
	1y growth	0.70***	(0.06)	0.166***	(0.047)	0.091	17	11	1011	0.73***	(0.06)	0.129***	(0.047)	4.535***	(1.297)	0.125	17	11	1011
	3y difference	0.67*	(0.08)	8.7e-04**	(3.6e-04)	0.004	15	11	949	0.72***	(0.05)	5.4e-04	(4.0e-04)	5.578***	(1.414)	0.070	15	11	949
	1y difference	0.66**	(0.07)	1.7e-03**	(8.5e-04)	0.002	17	11	1011	0.72***	(0.05)	8.8e-04	(9.5e-04)	5.990***	(1.484)	0.076	17	11	1011
	trend gap	0.69**	(0.07)	1.5e-03***	(5.6e-04)	0.006	14	10	895	0.70**	(0.05)	9.4e-04	(6.3e-04)	4.790***	(1.431)	0.052	14	10	895
	relative gap	0.69***	(0.06)	0.065**	(0.025)	0.059	14	10	895	0.71**	(0.06)	0.047	(0.030)	2.953	(1.904)	0.072	14	10	895
	5y m.a. gap	0.68**	(0.07)	1.3e-03**	(6.0e-04)	0.004	14	10	895	0.69***	(0.05)	8.1e-04	(6.5e-04)	4.828***	(1.415)	0.052	14	10	895
	m.a. gap	0.67***	(0.05)	4.4e-04***	(1.5e-04)	0.007	14	10	895	0.70***	(0.05)	3.2e-04*	(1.7e-04)	4.792***	(1.427)	0.054	14	10	895
	Debt-service-ratio (BIS)		0.65***	(0.06)	0.038	(0.038)	0.010	18	12	1297	0.68***	(0.05)	0.012	(0.038)	4.222**	(1.690)	0.038	18	12
3y growth		0.57	(0.06)	0.017	(0.014)	0.011	17	12	1177	0.66***	(0.05)	4.8e-03	(1.8e-02)	4.115**	(1.889)	0.038	17	12	1163
1y growth		0.64**	(0.04)	0.075***	(0.023)	0.039	17	12	1257	0.66***	(0.05)	0.061***	(0.021)	3.761***	(1.401)	0.063	17	12	1227
3y difference		0.57	(0.06)	0.103	(0.077)	0.013	17	12	1177	0.66***	(0.05)	0.029	(0.078)	4.029**	(1.963)	0.038	17	12	1163
1y difference		0.66***	(0.04)	0.399***	(0.152)	0.046	17	12	1257	0.67***	(0.05)	0.310***	(0.116)	3.544**	(1.390)	0.066	17	12	1227
trend gap		0.61*	(0.06)	0.111	(0.092)	0.014	17	12	1107	0.67***	(0.05)	-0.016	(0.142)	4.431	(2.830)	0.035	17	12	1107
relative gap		0.61**	(0.06)	0.023	(0.018)	0.014	17	12	1107	0.67**	(0.05)	-2.5e-03	(2.9e-02)	4.380	(2.736)	0.035	17	12	1107
5y m.a. gap		0.60	(0.06)	0.262**	(0.127)	0.029	17	12	1107	0.64**	(0.05)	0.160	(0.158)	3.058	(1.951)	0.044	17	12	1107
m.a. gap		0.69***	(0.05)	0.182***	(0.058)	0.058	17	12	1107	0.70***	(0.05)	0.146***	(0.053)	2.863*	(1.655)	0.071	17	12	1107
Debt-service-ratio (ESRB)			0.61**	(0.04)	1.525**	(0.676)	0.010	29	26	2190	0.70***	(0.05)	1.184***	(0.445)	5.156***	(1.293)	0.058	22	16
	3y growth	0.57	(0.05)	9.1e-03	(6.0e-03)	0.011	28	25	1925	0.67**	(0.05)	9.4e-03	(1.9e-02)	4.613**	(1.881)	0.051	22	16	1422
	1y growth	0.61**	(0.04)	0.020	(0.013)	0.009	28	26	2108	0.67***	(0.05)	0.039	(0.034)	4.736***	(1.483)	0.060	22	16	1462
	3y difference	0.59	(0.06)	8.224**	(3.905)	0.013	28	25	1925	0.70***	(0.05)	-1.256	(5.258)	5.434***	(1.784)	0.049	22	16	1422
	1y difference	0.64***	(0.04)	26.422***	(6.901)	0.028	28	26	2108	0.68***	(0.05)	21.153**	(9.431)	4.434***	(1.504)	0.068	22	16	1462
	trend gap	0.59	(0.05)	15.130***	(4.739)	0.022	23	23	1788	0.69**	(0.06)	-0.732	(9.183)	4.983**	(2.307)	0.042	20	15	1391
	relative gap	0.58	(0.05)	0.010	(0.011)	0.004	23	23	1788	0.70***	(0.05)	-0.022	(0.025)	6.298***	(2.186)	0.048	20	15	1391
	5y m.a. gap	0.62*	(0.06)	17.441***	(6.689)	0.026	23	23	1788	0.68***	(0.06)	7.740	(6.478)	4.036**	(1.596)	0.045	20	15	1391
	m.a. gap	0.71***	(0.04)	11.061***	(2.898)	0.052	23	23	1788	0.75***	(0.05)	9.243***	(3.203)	3.007*	(1.574)	0.073	20	15	1391
	Corporate debt-service-ratio (ESRB)		0.61	(0.07)	3.133***	(1.192)	0.037	17	25	1098	0.72***	(0.06)	1.210	(1.262)	5.221**	(2.389)	0.075	13	15
3y growth		0.58	(0.06)	0.017*	(0.010)	0.020	15	23	831	0.68***	(0.07)	-5.8e-03	(1.4e-02)	5.649***	(2.118)	0.060	13	15	762
1y growth		0.67***	(0.04)	0.052***	(0.019)	0.042	17	25	1007	0.69***	(0.07)	0.047***	(0.017)	4.882**	(1.963)	0.090	13	15	858
3y difference		0.58	(0.07)	4.207	(3.308)	0.011	15	23	831	0.67***	(0.07)	-2.823	(4.883)	6.022**	(2.373)	0.062	13	15	762
1y difference		0.67***	(0.04)	11.301**	(5.025)	0.025	17	25	1007	0.70**	(0.07)	15.418***	(5.760)	4.553**	(2.042)	0.093	13	15	858
trend gap		0.48	(0.10)	1.220	(7.455)	0.000	12	19	702	0.68**	(0.08)	-10.237	(9.517)	6.470**	(3.004)	0.056	12	14	677
relative gap		0.47	(0.10)	-3.3e-03	(2.2e-02)	0.000	12	19	702	0.69***	(0.08)	-0.036	(0.029)	6.335**	(2.695)	0.061	12	14	677
5y m.a. gap		0.60	(0.08)	8.203	(6.152)	0.017	12	19	702	0.64*	(0.08)	1.919	(7.299)	3.889*	(2.100)	0.040	12	14	677
m.a. gap		0.71***	(0.07)	7.731***	(2.615)	0.059	12	19	702	0.71**	(0.07)	6.513***	(2.326)	1.632	(2.569)	0.066	12	14	677
Household debt-service-ratio (ESRB)			0.66***	(0.06)	10.170***	(3.943)	0.047	17	25	1073	0.75***	(0.06)	16.114***	(4.922)	2.847	(2.207)	0.133	13	15
	3y growth	0.64**	(0.06)	0.012***	(0.004)	0.035	15	23	818	0.68***	(0.08)	9.9e-03**	(4.6e-03)	4.810**	(2.177)	0.071	13	15	749
	1y growth	0.68***	(0.05)	0.036***	(0.012)	0.037	17	25	986	0.69***	(0.07)	0.038*	(0.020)	5.703**	(2.283)	0.089	13	15	837
	3y difference	0.70***	(0.06)	37.433***	(11.740)	0.087	15	23	818	0.71***	(0.07)	37.532***	(12.416)	2.598	(2.551)	0.116	13	15	749
	1y difference	0.73***	(0.05)	71.491***	(22.088)	0.085	17	25	986	0.74***	(0.06)	83.616***	(24.264)	4.094	(2.531)	0.149	13	15	837
	trend gap	0.65**	(0.06)	45.413***	(17.149)	0.046	12	19	690	0.67**	(0.06)	35.911**	(18.003)	2.775	(2.507)	0.062	12	14	665
	relative gap	0.63*	(0.07)	0.021	(0.015)	0.014	12	19	690	0.64*	(0.07)	0.013	(0.014)	3.945*	(2.188)	0.044	12	14	665
	5y m.a. gap	0.72***	(0.06)	64.416***	(20.647)	0.097	12	19	690	0.72***	(0.07)	60.180***	(20.593)	2.024	(2.595)	0.108	12	14	665
	m.a. gap	0.71**	(0.07)	34.915***	(10.214)	0.100	12	19	690	0.70**	(0.07)	32.399***	(9.777)	0.804	(2.479)	0.100	12	14	665
	Household credit * 10y interest rate / GDP		0.56	(0.07)	0.208	(0.181)	0.011	17	20	996	0.67**	(0.07)	0.212	(0.194)	4.916***	(1.606)	0.071	16	17
3y growth		0.54	(0.05)	3.6e-03	(4.0e-03)	0.003	15	17	810	0.67***	(0.06)	-3.8e-04	(5.8e-03)	4.265**	(1.732)	0.048	15	17	810
1y growth		0.58***	(0.03)	9.0e-03**	(4.0e-03)	0.006	16	19	932	0.68***	(0.05)	0.010**	(0.004)	4.820***	(1.703)	0.064	16	17	923
3y difference		0.56	(0.05)	0.392	(0.265)	0.011	15	17	810	0.67***	(0.06)	0.104	(0.301)	4.058**	(1.861)	0.048	15	17	810
1y difference		0.60***	(0.03)	0.489*	(0.263)	0.011	16	19	932	0.68***	(0.05)	0.679***	(0.261)	4.728***	(1.707)	0.072	16	17	923
trend gap		0.47	(0.07)	-0.109	(0.507)	0.000	13	16	713	0.63*	(0.07)	-0.418	(0.599)	3.659*	(2.004)	0.032	13	16	713
relative gap		0.46	(0.07)	-8.1e-03	(8.2e-03)	0.008	13	16	713	0.64*	(0.07)	-0.012	(0.010)	3.668*	(1.943)	0.042	13	16	713
5y m.a. gap		0.56	(0.05)	0.599	(0.391)	0.010	13	16	713	0.62**	(0.06)	0.305	(0.425)	2.878	(1.850)	0.030	13	16	713
m.a. gap		0.55	(0.06)	0.215	(0.238)	0.005	13	16	713	0.63**	(0.06)	0.028	(0.246)	3.144*	(1.834)	0.028	13	16	713
Household credit * 3m interest rate / GDP			0.56	(0.06)	0.172	(0.140)	0.010	18	25	1363	0.68**	(0.07)	0.244*	(0.142)	5.796***	(1.810)	0.082	16	17
	3y growth	0.66***	(0.04)	4.6e-03***	(1.7e-03)	0.034	18	25	1119	0.72***	(0.05)	7.9e-03***	(2.5e-03)	4.496***	(1.663)	0.086	16	17	986
	1y growth	0.74***	(0.04)	0.018***	(0.005)	0.074	18	25	1284	0.79***	(0.04)	0.027***	(0.005)	6.254***	(1.833)	0.175	16	17	1086
	3y difference	0.68***	(0.04)	0.496***	(0.156)	0.049	18	25	1119	0.74***	(0.05)	0.734***	(0.155)	4.294***	(1.658)	0.128	16	17	986
	1y difference	0.74***	(0.03)	0.964***	(0.349)	0.072	18	25	1284	0.80***	(0.04)	1.484***	(0.215)	6.704***	(2.014)	0.204	16	17	1086
	trend gap	0.71***	(0.04)	0.831***	(0.262)	0.059	17	24	961	0.73***	(0.05)	0.977***	(0.228)	3.297**	(1.350)	0.108	15	16	

Panel C: Measures of potential overvaluation of property prices, ESCB Heads of Research crisis dataset

Indicator	Transformation	univariate				bivariate				Credit-to-GDP gap			
		AUC	Indicator Logit coeff.	pR2	Cr Co N	AUC	Indicator Logit coeff.	pR2	Cr Co N	Logit coeff.	pR2	Cr Co N	
Residential property real price	3y growth	0.67*** (0.05)	0.022** (0.009)	0.045	26 17 1383	0.68*** (0.04)	0.018 (0.011)	4.093*** (1.362)	0.067	22 14 1301			
	1y growth	0.61** (0.05)	0.043** (0.020)	0.033	26 19 1519	0.66*** (0.05)	0.028 (0.022)	4.726*** (1.316)	0.055	22 15 1345			
	relative gap	0.64*** (0.04)	0.032*** (0.011)	0.038	23 16 1288	0.67*** (0.04)	0.023* (0.014)	3.911*** (1.494)	0.065	22 14 1262			
Residential property price / rent	3y growth	0.68*** (0.06)	0.019* (0.010)	0.046	26 20 1445	0.67** (0.06)	0.012 (0.007)	3.853*** (1.184)	0.060	22 15 1364			
	1y growth	0.66*** (0.04)	0.018*** (0.006)	0.041	21 17 1268	0.69*** (0.04)	0.014 (0.011)	4.542*** (1.374)	0.068	19 14 1223			
	3y difference	0.62*** (0.05)	0.031 (0.019)	0.018	24 19 1379	0.69*** (0.04)	0.029 (0.025)	5.169*** (1.308)	0.066	22 15 1314			
	1y difference	0.69*** (0.04)	0.046*** (0.010)	0.084	21 17 1268	0.70*** (0.04)	0.035** (0.015)	3.685*** (1.301)	0.087	19 14 1223			
	trend gap	0.65*** (0.05)	0.066** (0.026)	0.044	24 19 1379	0.70*** (0.04)	0.060 (0.037)	4.826*** (1.310)	0.079	22 15 1314			
	relative gap	0.66*** (0.05)	0.054*** (0.020)	0.056	21 17 1177	0.69*** (0.04)	0.044* (0.025)	3.350** (1.496)	0.081	19 14 1146			
	5y m.a. gap	0.61** (0.05)	0.024* (0.013)	0.022	21 17 1177	0.68*** (0.04)	0.019 (0.016)	4.299*** (1.379)	0.063	19 14 1146			
	m.a. gap	0.70*** (0.04)	0.074*** (0.019)	0.088	21 17 1177	0.70*** (0.04)	0.057** (0.026)	3.540*** (1.271)	0.087	19 14 1146			
Residential property price / income	3y growth	0.72*** (0.04)	0.039*** (0.010)	0.110	21 17 1177	0.71*** (0.04)	0.029** (0.012)	1.703 (1.692)	0.089	19 14 1146			
	1y growth	0.71** (0.07)	0.021 (0.014)	0.055	25 21 1447	0.69** (0.07)	0.013 (0.012)	4.355*** (1.186)	0.065	21 15 1326			
	3y difference	0.69*** (0.04)	0.042*** (0.010)	0.086	21 18 1251	0.71*** (0.05)	0.035** (0.014)	3.918*** (1.187)	0.101	19 14 1176			
	1y difference	0.65*** (0.05)	0.071*** (0.022)	0.050	23 20 1377	0.69*** (0.04)	0.061** (0.028)	5.029*** (1.181)	0.083	21 15 1274			
	trend gap	0.71*** (0.05)	0.068*** (0.014)	0.126	21 18 1251	0.72*** (0.05)	0.060*** (0.020)	3.236*** (1.128)	0.121	19 14 1176			
	relative gap	0.67*** (0.05)	0.111*** (0.025)	0.085	23 20 1377	0.70*** (0.04)	0.098*** (0.034)	4.693*** (1.172)	0.100	21 15 1274			
	5y m.a. gap	0.67*** (0.06)	0.080*** (0.025)	0.079	21 18 1146	0.69*** (0.06)	0.060** (0.031)	3.771*** (1.341)	0.096	19 14 1092			
	m.a. gap	0.63** (0.05)	0.043*** (0.017)	0.042	21 18 1146	0.69*** (0.05)	0.033 (0.021)	4.395*** (1.368)	0.078	19 14 1092			
	5y m.a. gap	0.72*** (0.05)	0.113*** (0.025)	0.141	21 18 1146	0.72*** (0.05)	0.093*** (0.031)	3.443*** (1.263)	0.126	19 14 1092			
	m.a. gap	0.77*** (0.05)	0.062*** (0.014)	0.180	21 18 1146	0.75*** (0.04)	0.057*** (0.018)	0.101 (1.717)	0.142	19 14 1092			

Robust standard errors adjusted for clustering are reported in the parentheses. **, * and *** indicate statistical significance at the 10%, 5% and 1%-level.

Panel D: Measures of external imbalances, ESCB Heads of Research crisis dataset

Indicator	Transformation	univariate				bivariate				Credit-to-GDP gap			
		AUC	Indicator Logit coeff.	pR2	Cr Co N	AUC	Indicator Logit coeff.	pR2	Cr Co N	Logit coeff.	pR2	Cr Co N	
Current account / GDP	3y growth	0.44 (0.05)	-0.141 (0.090)	0.010	26 26 1788	0.67*** (0.05)	-0.141 (0.151)	4.744*** (1.445)	0.056	20 17 1254			
	1y growth	0.57* (0.04)	5.8e-06 (2.3e-05)	0.000	24 26 1532	0.69*** (0.06)	3.2e-06 (1.1e-05)	5.025*** (1.487)	0.054	20 17 1128			
	3y difference	0.54 (0.03)	3.9e-05 (5.8e-05)	0.001	26 26 1704	0.69*** (0.05)	2.6e-05 (5.9e-05)	5.037*** (1.419)	0.052	20 17 1220			
	1y difference	0.40** (0.04)	-0.228** (0.113)	0.014	24 26 1533	0.68*** (0.05)	-0.210 (0.234)	4.684*** (1.505)	0.058	20 17 1128			
	1y difference	0.43*** (0.03)	-0.177 (0.108)	0.005	26 26 1705	0.68*** (0.05)	-0.168 (0.273)	4.972*** (1.420)	0.053	20 17 1220			
Capital account / GDP	3y growth	0.50 (0.04)	20.669 (48.383)	0.000	18 21 1021	0.68*** (0.06)	-75.686 (97.844)	4.737*** (1.726)	0.049	16 17 898			
	1y growth	0.51 (0.03)	4.1e-05 (5.1e-05)	0.001	14 21 730	0.67*** (0.05)	6.6e-05 (4.7e-05)	3.933** (1.620)	0.044	13 17 660			
	3y difference	0.45* (0.03)	-5.9e-05 (7.8e-05)	0.000	17 21 884	0.67*** (0.05)	-9.9e-05 (8.1e-05)	4.250*** (1.592)	0.047	15 17 781			
	1y difference	0.48 (0.05)	49.596 (56.970)	0.002	16 21 787	0.68*** (0.05)	1.644 (154.752)	4.280*** (1.648)	0.049	15 17 715			
	1y difference	0.51 (0.03)	10.994 (17.340)	0.000	18 21 941	0.68*** (0.05)	28.661 (68.375)	4.480*** (1.635)	0.049	16 17 836			
Portfolio investments / GDP	3y growth	0.48 (0.07)	-0.379 (0.600)	0.005	16 21 622	0.66** (0.07)	0.949 (0.580)	3.378 (2.087)	0.049	14 17 533			
	1y growth	0.49 (0.07)	-7.3e-05 (1.8e-04)	0.000	12 20 382	0.59 (0.10)	4.6e-04 (1.6e-03)	1.002 (2.200)	0.003	10 16 343			
	3y difference	0.45 (0.05)	-1.4e-04 (2.3e-04)	0.001	16 21 537	0.63 (0.09)	-5.9e-05 (2.6e-04)	2.761 (2.050)	0.024	14 17 466			
	1y difference	0.48 (0.08)	-0.972 (0.681)	0.011	12 20 382	0.56 (0.10)	-0.317 (0.689)	0.993 (2.192)	0.004	10 16 343			
	1y difference	0.49 (0.07)	-1.403* (0.717)	0.014	16 21 537	0.61 (0.09)	-1.247 (1.353)	2.625 (2.028)	0.028	14 17 466			
Other investments / GDP	3y growth	0.48 (0.07)	-0.379 (0.600)	0.005	16 21 622	0.66** (0.07)	0.949 (0.580)	3.378 (2.087)	0.049	14 17 533			
	1y growth	0.49 (0.07)	-7.3e-05 (1.8e-04)	0.000	12 20 382	0.59 (0.10)	4.6e-04 (1.6e-03)	1.002 (2.200)	0.003	10 16 343			
	3y difference	0.45 (0.05)	-1.4e-04 (2.3e-04)	0.001	16 21 537	0.63 (0.08)	-5.9e-05 (2.6e-04)	2.761 (2.050)	0.024	14 17 466			
	1y difference	0.48 (0.08)	-0.972 (0.681)	0.011	12 20 382	0.56 (0.10)	-0.317 (0.689)	0.993 (2.192)	0.004	10 16 343			
	1y difference	0.49 (0.07)	-1.403* (0.717)	0.014	16 21 537	0.61 (0.09)	-1.247 (1.353)	2.625 (2.028)	0.028	14 17 466			

Robust standard errors adjusted for clustering are reported in the parentheses. **, * and *** indicate statistical significance at the 10%, 5% and 1%-level.

Panel E: Measures of potential mispricing of risk, ESCB Heads of Research crisis dataset

Indicator	Transformation	univariate				bivariate				Credit-to-GDP gap									
		AUC	Indicator Logit coeff.	pR2	Cr	Co	N	AUC	Indicator Logit coeff.	Logit coeff.	pR2	Cr	Co	N					
Stock market volatility		0.40***	(0.04)	-4.629**	(1.821)	0.020	30	27	2116	0.69***	(0.04)	-6.126**	(2.390)	5.947***	(1.388)	0.079	23	17	1555
	3y growth	0.40***	(0.03)	-6.8e-03***	(1.8e-03)	0.027	29	27	1865	0.71***	(0.03)	-9.8e-03***	(2.4e-03)	6.255***	(1.254)	0.104	23	17	1468
	1y growth	0.50	(0.02)	-1.6e-03	(1.1e-03)	0.001	29	27	2034	0.69***	(0.05)	-8.3e-04	(1.4e-03)	5.333***	(1.260)	0.052	23	17	1535
	3y difference	0.40***	(0.03)	-2.097***	(0.774)	0.011	29	27	1866	0.71***	(0.03)	-4.393***	(1.141)	6.031***	(1.221)	0.092	23	17	1468
	1y difference	0.49	(0.02)	-0.178	(0.386)	0.000	29	27	2035	0.69***	(0.05)	0.047	(0.606)	5.345***	(1.262)	0.051	23	17	1535
Stock market index	3y growth	0.58*	(0.05)	1.8e-03	(2.3e-03)	0.003	18	14	922	0.68**	(0.07)	4.8e-03*	(2.6e-03)	5.590***	(1.691)	0.074	17	13	876
	1y growth	0.62***	(0.03)	8.8e-03***	(2.8e-03)	0.012	20	14	1016	0.71***	(0.05)	0.018***	(0.004)	6.389***	(1.568)	0.099	19	13	954
Bank stock index	3y growth	0.65**	(0.06)	5.8e-03**	(2.9e-03)	0.027	16	13	1015	0.72***	(0.05)	8.4e-03***	(3.0e-03)	5.913***	(1.495)	0.099	16	13	1015
	1y growth	0.61***	(0.04)	6.1e-03**	(2.7e-03)	0.006	18	13	1106	0.68***	(0.03)	0.011***	(0.003)	5.271***	(1.273)	0.062	18	13	1106
Stock market P/E ratio		0.44	(0.04)	-0.030**	(0.012)	0.025	15	22	766	0.66**	(0.07)	-0.042**	(0.017)	4.430*	(2.305)	0.075	12	16	664
	3y growth	0.26***	(0.07)	-0.015**	(0.006)	0.145	13	21	523	0.76***	(0.06)	-0.016**	(0.007)	3.869**	(1.860)	0.173	12	16	496
	1y growth	0.46	(0.03)	-5.5e-04	(1.1e-03)	0.004	15	22	686	0.67**	(0.06)	-6.6e-03***	(1.3e-03)	4.278**	(2.177)	0.071	12	16	612
	3y difference	0.26***	(0.06)	-0.022**	(0.009)	0.113	13	21	523	0.73***	(0.07)	-0.025**	(0.010)	4.815**	(1.996)	0.161	12	16	496
	1y difference	0.46	(0.03)	-2.8e-04**	(1.1e-04)	0.000	15	22	686	0.64*	(0.08)	-3.7e-04**	(1.5e-04)	4.071*	(2.213)	0.041	12	16	612
Stock market P/B ratio		0.80***	(0.09)	1.999**	(0.980)	0.198	12	14	152	0.80***	(0.11)	2.008*	(1.045)	-1.779	(2.618)	0.208	12	14	152
	1y growth	0.64***	(0.04)	0.021***	(0.008)	0.048	10	13	98	0.66***	(0.05)	0.020**	(0.009)	-1.711	(2.542)	0.060	10	13	98
	1y difference	0.66***	(0.04)	1.817***	(0.462)	0.090	10	13	98	0.68***	(0.04)	1.762***	(0.513)	-1.582	(2.465)	0.100	10	13	98
Stock market dividend yield		0.33***	(0.04)	-0.774***	(0.194)	0.076	12	14	378	0.68***	(0.05)	-0.823***	(0.207)	1.916	(1.912)	0.085	12	14	378
	3y growth	0.21***	(0.04)	-0.035***	(0.008)	0.227	12	14	210	0.80***	(0.04)	-0.037***	(0.008)	1.767	(2.368)	0.235	12	14	210
	1y growth	0.44	(0.05)	-0.012**	(0.005)	0.023	12	14	322	0.58	(0.06)	-0.012**	(0.005)	0.674	(2.034)	0.024	12	14	322
	3y difference	0.19***	(0.04)	-1.394***	(0.309)	0.248	12	14	210	0.81***	(0.04)	-1.483***	(0.295)	1.997	(2.357)	0.258	12	14	210
	1y difference	0.43	(0.06)	-0.144	(0.089)	0.005	12	14	322	0.59*	(0.07)	-0.147	(0.099)	0.536	(1.992)	0.006	12	14	322
Household lending spread		0.37	(0.07)	-0.207	(0.262)	0.010	17	27	470	0.71**	(0.09)	-0.704	(0.674)	0.346	(2.288)	0.060	13	17	337
	3y growth	0.19***	(0.06)	-0.031**	(0.013)	0.221	14	22	165	0.82***	(0.07)	-0.030*	(0.016)	-0.135	(2.571)	0.229	11	17	141
	1y growth	0.37*	(0.06)	-6.7e-04	(1.0e-03)	0.003	17	27	362	0.63*	(0.07)	-1.1e-03	(2.8e-03)	0.963	(1.995)	0.009	13	17	269
	3y difference	0.19***	(0.07)	-1.462**	(0.611)	0.226	14	22	165	0.84***	(0.07)	-1.642*	(0.887)	0.553	(2.757)	0.259	11	17	141
	1y difference	0.38**	(0.05)	-0.296	(0.257)	0.015	17	27	362	0.70***	(0.06)	-0.666	(0.653)	1.439	(2.061)	0.048	13	17	269
Corporate lending spread		0.37**	(0.06)	-0.673**	(0.297)	0.039	16	26	453	0.64**	(0.06)	-0.653	(0.426)	1.473	(2.107)	0.033	12	16	320
	3y growth	0.27***	(0.09)	-0.042***	(0.013)	0.154	14	21	157	0.70*	(0.10)	-0.040***	(0.015)	-0.765	(2.036)	0.129	11	16	133
	1y growth	0.46	(0.04)	-7.3e-03	(5.4e-03)	0.009	16	26	349	0.62**	(0.06)	-0.017***	(0.006)	1.740	(1.979)	0.033	12	16	256
	3y difference	0.25***	(0.08)	-2.726***	(0.830)	0.173	14	21	157	0.72*	(0.09)	-2.810***	(1.014)	-0.798	(1.998)	0.152	11	16	133
	1y difference	0.45	(0.05)	-0.316	(0.287)	0.005	16	26	349	0.60**	(0.06)	-1.152***	(0.375)	1.557	(1.968)	0.035	12	16	256
High-yield spread		0.12***	(0.02)	-0.010***	(0.002)	0.317	17	27	1017	0.92***	(0.01)	-0.015***	(0.002)	5.512**	(2.397)	0.451	13	17	635
	3y growth	0.29***	(0.03)	-0.015***	(0.004)	0.142	17	27	732	0.81***	(0.04)	-0.026***	(0.002)	5.026**	(2.296)	0.270	13	17	448
	1y growth	0.48	(0.01)	-4.8e-03***	(6.7e-04)	0.015	17	27	926	0.61*	(0.06)	-5.6e-03***	(7.2e-04)	2.693	(2.004)	0.034	13	17	579
	3y difference	0.31***	(0.03)	-1.2e-03***	(1.9e-04)	0.068	17	27	732	0.75***	(0.04)	-1.7e-03***	(2.6e-04)	3.606*	(2.070)	0.134	13	17	448
	1y difference	0.53*	(0.01)	-6.2e-05	(1.0e-04)	0.000	17	27	926	0.58	(0.07)	7.1e-06	(1.2e-04)	2.451	(2.039)	0.016	13	17	579
	trend gap	0.48	(0.04)	-4.9e-04**	(2.3e-04)	0.005	17	27	555	0.57	(0.09)	-6.7e-04	(5.0e-04)	1.990	(2.116)	0.016	13	17	329
	relative gap	0.48	(0.03)	-7.1e-03***	(1.5e-03)	0.037	17	27	555	0.61	(0.08)	-1.0e-02***	(2.4e-03)	2.682	(2.019)	0.064	13	17	329
	5y m.a. gap	0.48	(0.04)	-7.1e-04***	(2.6e-04)	0.011	17	27	555	0.59	(0.09)	-1.1e-03**	(5.2e-04)	2.327	(2.130)	0.028	13	17	329
	m.a. gap	0.49	(0.03)	-2.8e-03***	(5.0e-04)	0.058	17	27	555	0.68***	(0.07)	-4.4e-03***	(8.1e-04)	3.787*	(2.168)	0.112	13	17	329
	CBOE Volatility Index		0.27***	(0.03)	-0.130***	(0.030)	0.090	34	27	1948	0.83***	(0.03)	-0.208***	(0.042)	8.464***	(1.735)	0.248	18	17
3y growth		0.14***	(0.03)	-0.042***	(0.011)	0.232	32	27	1638	0.94***	(0.01)	-0.091***	(0.018)	7.822***	(2.809)	0.504	17	17	1017
1y growth		0.31***	(0.02)	-0.021***	(0.003)	0.045	34	27	1844	0.74***	(0.04)	-0.029***	(0.003)	5.891***	(1.452)	0.128	18	17	1121
3y difference		0.15***	(0.03)	-0.161***	(0.029)	0.245	32	27	1638	0.94***	(0.01)	-0.276***	(0.043)	7.693***	(2.461)	0.490	17	17	1017
1y difference		0.32***	(0.02)	-0.069***	(0.009)	0.031	34	27	1844	0.72***	(0.04)	-0.090***	(0.013)	5.760***	(1.469)	0.103	18	17	1121
trend gap		0.11***	(0.03)	-0.275***	(0.051)	0.319	23	27	1507	0.96***	(0.01)	-0.506***	(0.113)	5.999**	(2.730)	0.568	14	17	948
relative gap		0.10***	(0.03)	-0.062***	(0.014)	0.335	23	27	1507	0.97***	(0.01)	-0.139***	(0.046)	6.163**	(3.059)	0.604	14	17	948
5y m.a. gap		0.14***	(0.03)	-0.266***	(0.047)	0.254	23	27	1507	0.93***	(0.02)	-0.421***	(0.043)	6.569***	(2.267)	0.459	14	17	948
m.a. gap		0.11***	(0.02)	-0.388***	(0.123)	0.301	23	27	1507	0.94***	(0.02)	-0.788***	(0.240)	9.801**	(4.198)	0.500	14	17	948

continues on next page...

German 10y Bund		0.39***	(0.04)	-0.210***	(0.081)	0.022	43	27	3633	0.67***	(0.04)	-0.138	(0.168)	4.659**	(1.988)	0.060	24	17	1726
3y growth		0.53	(0.03)	1.9e-03	(3.5e-03)	0.000	42	27	3314	0.70***	(0.05)	-3.6e-04	(5.4e-03)	5.661***	(1.222)	0.054	24	17	1726
1y growth		0.55*	(0.02)	8.9e-03*	(4.9e-03)	0.003	42	27	3528	0.68***	(0.05)	8.2e-03	(7.0e-03)	5.781***	(1.211)	0.056	24	17	1726
3y difference		0.57**	(0.03)	0.092**	(0.047)	0.004	42	27	3314	0.69***	(0.04)	0.084	(0.072)	5.691***	(1.207)	0.057	24	17	1726
1y difference		0.55*	(0.03)	0.109	(0.079)	0.002	42	27	3528	0.68***	(0.05)	0.065	(0.140)	5.686***	(1.209)	0.054	24	17	1726
trend gap		0.60***	(0.02)	0.220***	(0.071)	0.008	40	27	3136	0.69***	(0.05)	0.118	(0.127)	5.660***	(1.215)	0.056	24	17	1726
relative gap		0.57***	(0.02)	0.013***	(0.005)	0.006	40	27	3136	0.69***	(0.05)	4.7e-03	(7.7e-03)	5.681***	(1.223)	0.054	24	17	1726
5y m.a. gap		0.59***	(0.03)	0.191**	(0.075)	0.007	40	27	3136	0.69***	(0.04)	0.131	(0.116)	5.703***	(1.208)	0.056	24	17	1726
m.a. gap		0.42*	(0.04)	-0.170	(0.104)	0.008	40	27	3136	0.67***	(0.04)	-0.141	(0.198)	4.993***	(1.791)	0.058	24	17	1726
German 1y bill		0.50	(0.04)	0.051	(0.066)	0.002	37	27	2424	0.70***	(0.03)	-8.5e-03	(1.0e-01)	5.313***	(1.589)	0.055	21	17	1402
3y growth		0.63***	(0.02)	8.4e-03***	(1.5e-03)	0.032	35	27	2130	0.71***	(0.03)	7.5e-03***	(1.8e-03)	5.552***	(1.318)	0.081	19	17	1264
1y growth		0.72***	(0.03)	0.025***	(0.003)	0.085	37	27	2324	0.79***	(0.02)	0.029***	(0.003)	6.700***	(1.079)	0.169	21	17	1354
3y difference		0.65***	(0.02)	0.210***	(0.039)	0.038	35	27	2130	0.71***	(0.03)	0.181***	(0.041)	5.471***	(1.322)	0.083	19	17	1264
1y difference		0.70***	(0.03)	0.511***	(0.107)	0.065	37	27	2324	0.76***	(0.03)	0.621***	(0.110)	6.756***	(1.087)	0.144	21	17	1354
trend gap		0.70***	(0.03)	0.433***	(0.075)	0.072	34	27	1948	0.75***	(0.04)	0.487***	(0.078)	6.000***	(1.519)	0.130	18	17	1173
relative gap		0.72***	(0.03)	0.020***	(0.003)	0.083	34	27	1948	0.77***	(0.03)	0.024***	(0.004)	6.177***	(1.487)	0.152	18	17	1173
5y m.a. gap		0.67***	(0.02)	0.368***	(0.069)	0.049	34	27	1948	0.73***	(0.03)	0.429***	(0.060)	5.953***	(1.455)	0.113	18	17	1173
m.a. gap		0.60**	(0.04)	0.189**	(0.074)	0.021	34	27	1948	0.68***	(0.05)	0.083	(0.099)	5.470***	(1.602)	0.060	18	17	1173
German 1m bill		0.45	(0.04)	-0.028	(0.053)	0.001	37	27	2816	0.71***	(0.03)	-0.051	(0.097)	5.490***	(1.608)	0.063	21	17	1586
3y growth		0.60***	(0.02)	2.0e-03**	(8.6e-04)	0.003	37	27	2524	0.69***	(0.03)	2.2e-03*	(1.3e-03)	5.572***	(1.108)	0.058	21	17	1450
1y growth		0.66***	(0.03)	9.7e-03***	(1.9e-03)	0.023	37	27	2720	0.72***	(0.03)	0.014***	(0.003)	6.780***	(1.044)	0.100	21	17	1542
3y difference		0.62***	(0.02)	0.087***	(0.024)	0.012	37	27	2524	0.68***	(0.03)	0.071	(0.044)	5.486***	(1.092)	0.061	21	17	1450
1y difference		0.63***	(0.03)	0.177***	(0.054)	0.014	37	27	2720	0.69***	(0.03)	0.252***	(0.086)	6.550***	(1.069)	0.083	21	17	1542
trend gap		0.72***	(0.03)	0.413***	(0.077)	0.077	37	27	2349	0.71***	(0.03)	0.298***	(0.115)	5.238***	(1.082)	0.089	21	17	1366
relative gap		0.73***	(0.03)	0.020***	(0.003)	0.076	37	27	2349	0.74***	(0.03)	0.018***	(0.004)	5.638***	(1.049)	0.111	21	17	1366
5y m.a. gap		0.68***	(0.03)	0.385***	(0.078)	0.058	37	27	2349	0.70***	(0.03)	0.296***	(0.107)	5.549***	(1.062)	0.085	21	17	1366
m.a. gap		0.56	(0.04)	0.176**	(0.082)	0.016	37	27	2349	0.69***	(0.04)	0.032	(0.109)	5.483***	(1.341)	0.056	21	17	1366
US 10y T-note		0.43**	(0.04)	-0.116**	(0.054)	0.012	43	27	3633	0.70***	(0.05)	-7.5e-03	(9.9e-02)	5.585***	(2.087)	0.054	24	17	1726
3y growth		0.58**	(0.03)	6.7e-03**	(3.4e-03)	0.005	42	27	3314	0.72***	(0.03)	0.021***	(0.004)	6.851***	(1.221)	0.096	24	17	1726
1y growth		0.53	(0.02)	5.7e-03*	(3.2e-03)	0.001	42	27	3528	0.69***	(0.04)	0.015***	(0.003)	5.837***	(1.194)	0.063	24	17	1726
3y difference		0.56**	(0.03)	0.036	(0.044)	0.001	42	27	3314	0.70***	(0.03)	0.182***	(0.062)	6.205***	(1.209)	0.073	24	17	1726
1y difference		0.50	(0.02)	0.025	(0.038)	0.000	42	27	3528	0.68***	(0.04)	0.128**	(0.054)	5.761***	(1.176)	0.057	24	17	1726
trend gap		0.51	(0.05)	-0.025	(0.084)	0.000	40	27	3136	0.68***	(0.03)	0.196	(0.122)	5.395***	(1.240)	0.065	24	17	1726
relative gap		0.55	(0.05)	0.013	(0.009)	0.008	40	27	3136	0.72***	(0.03)	0.038***	(0.012)	5.125***	(1.199)	0.108	24	17	1726
5y m.a. gap		0.56*	(0.03)	0.047	(0.057)	0.001	40	27	3136	0.70***	(0.03)	0.262***	(0.084)	6.136***	(1.182)	0.071	24	17	1726
m.a. gap		0.40***	(0.03)	-0.146***	(0.053)	0.018	40	27	3136	0.70***	(0.05)	0.012	(0.093)	5.781***	(1.872)	0.054	24	17	1726
US 1y T-bill		0.50	(0.04)	0.017	(0.036)	0.000	37	27	2424	0.69***	(0.06)	0.125*	(0.069)	6.746***	(1.908)	0.073	21	17	1402
3y growth		0.75***	(0.04)	9.0e-03***	(1.6e-03)	0.143	35	27	2130	0.86***	(0.03)	0.013***	(0.003)	6.368***	(1.206)	0.321	19	17	1264
1y growth		0.69***	(0.03)	0.014***	(0.002)	0.062	37	27	2324	0.80***	(0.03)	0.021***	(0.002)	6.143***	(0.961)	0.192	21	17	1354
3y difference		0.74***	(0.04)	0.329***	(0.070)	0.110	35	27	2130	0.84***	(0.03)	0.559***	(0.119)	7.312***	(1.326)	0.284	19	17	1264
1y difference		0.67***	(0.03)	0.339***	(0.063)	0.049	37	27	2324	0.78***	(0.03)	0.551***	(0.103)	6.265***	(1.002)	0.159	21	17	1354
trend gap		0.69***	(0.03)	0.479***	(0.123)	0.064	34	27	1948	0.82***	(0.04)	0.915***	(0.220)	7.807***	(1.626)	0.229	18	17	1173
relative gap		0.71***	(0.04)	0.022***	(0.005)	0.113	34	27	1948	0.86***	(0.04)	0.039***	(0.008)	7.554***	(1.472)	0.336	18	17	1173
5y m.a. gap		0.74***	(0.04)	0.544***	(0.133)	0.109	34	27	1948	0.87***	(0.04)	1.059***	(0.256)	7.983***	(1.677)	0.335	18	17	1173
m.a. gap		0.66***	(0.03)	0.367***	(0.100)	0.047	34	27	1948	0.77***	(0.04)	0.585***	(0.132)	7.119***	(1.593)	0.157	18	17	1173
US 1m T-bill		0.44	(0.04)	-0.048*	(0.028)	0.005	37	27	2816	0.70***	(0.04)	0.044	(0.050)	6.502***	(1.755)	0.064	21	17	1586
3y growth		0.72***	(0.03)	7.4e-03***	(1.3e-03)	0.117	37	27	2524	0.82***	(0.03)	0.010***	(0.002)	6.248***	(0.857)	0.259	21	17	1450
1y growth		0.69***	(0.03)	0.015***	(0.002)	0.079	37	27	2720	0.80***	(0.03)	0.022***	(0.003)	7.168***	(0.866)	0.233	21	17	1542
3y difference		0.69***	(0.03)	0.145***	(0.030)	0.043	37	27	2524	0.77***	(0.03)	0.239***	(0.050)	6.563***	(0.936)	0.151	21	17	1450
1y difference		0.65***	(0.03)	0.123***	(0.028)	0.015	37	27	2720	0.72***	(0.03)	0.225***	(0.051)	6.412***	(1.001)	0.100	21	17	1542
trend gap		0.68***	(0.03)	0.351***	(0.083)	0.062	37	27	2349	0.76***	(0.04)	0.455***	(0.156)	5.738***	(0.966)	0.142	21	17	1366
relative gap		0.70***	(0.03)	0.016***	(0.003)	0.109	37	27	2349	0.81***	(0.04)	0.023***	(0.005)	6.342***	(1.112)	0.258	21	17	1366
5y m.a. gap		0.74***	(0.04)	0.492***	(0.103)	0.114	37	27	2349	0.81***	(0.04)	0.697***	(0.181)	6.802***	(1.017)	0.244	21	17	1366
m.a. gap		0.63***	(0.03)	0.305***	(0.089)	0.033	37	27	2349	0.75***	(0.04)	0.508***	(0.105)	7.247***	(1.347)	0.140	21	17	1366

Robust standard errors adjusted for clustering are reported in the parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1%-level.

Panel F: Measures of the strength of bank balance sheets, ESCB Heads of Research crisis dataset

Indicator	Transformation	univariate					bivariate												
		AUC	Indicator Logit coeff.	pR2	Cr	Co N	AUC	Indicator Logit coeff.	Credit-to-GDP gap Logit coeff.										
Leverage ratio		0.33***	(0.05)	-0.260***	(0.072)	0.057	16	26	743	0.64*	(0.07)	-0.243***	(0.090)	1.736	(1.947)	0.050	13	17	570
	3y growth	0.37*	(0.06)	-0.024	(0.019)	0.022	16	25	435	0.59	(0.07)	-0.015	(0.021)	0.197	(2.327)	0.009	13	17	366
	1y growth	0.42*	(0.04)	-0.023	(0.018)	0.009	16	26	639	0.55	(0.07)	-9.4e-03	(2.4e-02)	1.461	(2.089)	0.007	13	17	502
	3y difference	0.40	(0.06)	-0.165	(0.178)	0.007	16	25	435	0.53	(0.06)	-0.050	(0.204)	0.498	(2.229)	0.002	13	17	366
	1y difference	0.43	(0.04)	-0.247	(0.185)	0.007	16	26	639	0.54	(0.06)	-0.098	(0.289)	1.479	(2.072)	0.007	13	17	502
Loans / deposits		0.57	(0.07)	5.7e-03**	(2.9e-03)	0.016	16	26	525	0.57	(0.08)	4.8e-03	(2.9e-03)	1.125	(1.832)	0.022	13	17	387
	3y growth	0.45	(0.09)	-8.1e-03	(1.7e-02)	0.005	15	24	220	0.62	(0.09)	-0.011	(0.028)	-0.695	(2.365)	0.008	12	17	186
	1y growth	0.56	(0.06)	0.025	(0.026)	0.007	16	26	421	0.55	(0.06)	0.030	(0.039)	1.563	(2.006)	0.015	13	17	319
	3y difference	0.47	(0.08)	1.8e-03	(1.6e-02)	0.000	15	24	220	0.54	(0.11)	0.011	(0.024)	-1.020	(2.422)	0.007	12	17	186
	1y difference	0.59	(0.06)	0.042*	(0.024)	0.025	16	26	421	0.58	(0.06)	0.055**	(0.026)	1.215	(2.049)	0.037	13	17	319
Total assets / GDP		0.65***	(0.06)	0.032**	(0.016)	0.008	15	21	771	0.66***	(0.06)	0.309**	(0.154)	2.078	(2.137)	0.056	13	17	664
	3y growth	0.53	(0.06)	4.6e-03	(9.1e-03)	0.001	15	20	523	0.55	(0.07)	3.3e-03	(1.1e-02)	1.432	(2.345)	0.007	13	17	484
	1y growth	0.61**	(0.05)	0.040**	(0.020)	0.015	15	21	687	0.61	(0.06)	0.031	(0.022)	2.099	(2.059)	0.024	13	17	604
	3y difference	0.62	(0.06)	0.449*	(0.270)	0.018	15	20	523	0.62	(0.07)	0.957*	(0.503)	0.107	(2.545)	0.034	13	17	484
	1y difference	0.64**	(0.06)	0.973*	(0.535)	0.028	15	21	687	0.65*	(0.07)	2.473***	(0.821)	1.072	(2.214)	0.058	13	17	604
Non-core liabilities / GDP		0.64*	(0.08)	0.057**	(0.023)	0.015	14	20	400	0.65**	(0.08)	0.548**	(0.266)	1.150	(1.812)	0.051	12	16	349
	3y growth	0.30*	(0.09)	-0.022*	(0.013)	0.067	12	19	174	0.68*	(0.09)	-0.027*	(0.015)	0.776	(2.915)	0.072	11	16	160
	1y growth	0.53	(0.06)	6.6e-03	(1.9e-02)	0.001	14	20	320	0.57	(0.08)	-5.6e-05	(2.1e-02)	1.703	(2.075)	0.010	12	16	285
	3y difference	0.61	(0.12)	1.244	(0.759)	0.050	12	19	174	0.58	(0.11)	1.058	(1.214)	-1.324	(2.433)	0.016	11	16	160
	1y difference	0.63*	(0.08)	3.090**	(1.260)	0.069	14	20	320	0.62*	(0.08)	3.288*	(1.682)	0.490	(2.008)	0.049	12	16	285
Non-core liabilities / Total assets		0.68***	(0.07)	4.470**	(1.900)	0.066	15	25	478	0.66**	(0.08)	3.944	(2.808)	0.959	(1.738)	0.054	12	16	349
	3y growth	0.45	(0.09)	-3.6e-03	(1.9e-02)	0.001	13	23	192	0.61	(0.10)	-0.037	(0.030)	-0.488	(2.563)	0.040	11	16	160
	1y growth	0.52	(0.06)	0.011	(0.022)	0.002	15	25	378	0.57	(0.08)	-0.014	(0.034)	1.677	(1.977)	0.012	12	16	285
	3y difference	0.48	(0.09)	1.613	(5.433)	0.002	13	23	192	0.58	(0.09)	-4.100	(10.221)	-0.368	(2.508)	0.006	11	16	160
	1y difference	0.55	(0.05)	7.937	(5.666)	0.012	15	25	378	0.56	(0.06)	5.835	(9.987)	1.657	(2.023)	0.014	12	16	285
Foreign currency cross border loans / GDP		0.70**	(0.06)	0.435***	(0.117)	0.006	13	15	878	0.74***	(0.04)	13.582**	(5.555)	2.939	(2.592)	0.069	11	11	798
	3y growth	0.44	(0.07)	-4.0e-03	(2.6e-03)	0.018	12	14	685	0.64*	(0.08)	-4.6e-03*	(2.4e-03)	4.277**	(1.995)	0.054	10	11	649
	1y growth	0.51	(0.05)	-2.9e-03	(3.4e-03)	0.003	13	15	791	0.63**	(0.07)	-2.3e-03	(3.3e-03)	4.030**	(1.947)	0.035	11	11	727
	3y difference	0.61	(0.07)	-1.480*	(0.873)	0.002	13	14	714	0.68***	(0.06)	19.357*	(11.128)	3.373	(2.189)	0.041	11	11	678
	1y difference	0.65***	(0.05)	3.302***	(1.153)	0.005	13	15	822	0.73***	(0.05)	77.876***	(29.641)	3.439	(2.191)	0.073	11	11	758
	trend gap	0.66***	(0.06)	0.748	(1.890)	0.000	12	13	632	0.70***	(0.06)	46.879**	(19.240)	2.906	(2.110)	0.055	11	11	608
	relative gap	0.58	(0.07)	3.6e-03	(2.9e-03)	0.008	12	13	620	0.63*	(0.07)	2.3e-03	(2.8e-03)	3.286	(2.018)	0.033	11	11	596
	5y m.a. gap	0.67***	(0.06)	5.762	(4.382)	0.006	12	13	632	0.71***	(0.06)	43.180**	(17.812)	3.179	(2.164)	0.055	11	11	608
	m.a. gap	0.69***	(0.07)	6.707	(5.558)	0.009	12	13	632	0.73***	(0.05)	22.138***	(7.190)	3.142	(2.145)	0.055	11	11	608
			0.69***	(0.06)	0.714***	(0.173)	0.009	13	15	878	0.76***	(0.03)	18.126***	(6.919)	2.615	(2.753)	0.075	11	11
Own currency cross border loans / GDP		0.44	(0.06)	-4.2e-03*	(2.3e-03)	0.022	12	14	685	0.65*	(0.09)	-5.8e-03**	(2.5e-03)	4.686**	(2.040)	0.065	10	11	649
	3y growth	0.50	(0.05)	-3.8e-03	(3.1e-03)	0.005	13	15	791	0.63*	(0.07)	-3.7e-03	(3.0e-03)	4.101**	(1.941)	0.038	11	11	727
	1y growth	0.62*	(0.07)	2.238**	(1.140)	0.003	13	14	714	0.66***	(0.06)	11.211	(17.645)	3.415	(2.297)	0.033	11	11	678
	3y difference	0.62**	(0.05)	6.320***	(1.299)	0.012	13	15	822	0.68***	(0.06)	34.152	(31.937)	3.728*	(2.179)	0.044	11	11	758
	1y difference	0.65**	(0.06)	15.519*	(9.417)	0.016	12	13	632	0.66**	(0.06)	29.520	(32.000)	3.432	(2.210)	0.039	11	11	608
	trend gap	0.56	(0.08)	3.1e-03	(3.2e-03)	0.006	12	13	620	0.63	(0.07)	1.6e-03	(3.5e-03)	3.371*	(2.033)	0.032	11	11	596
	relative gap	0.68***	(0.06)	23.301*	(12.681)	0.036	12	13	632	0.70***	(0.05)	49.174**	(25.045)	3.117	(2.160)	0.053	11	11	608
	5y m.a. gap	0.75***	(0.06)	23.324**	(10.644)	0.054	12	13	632	0.76***	(0.04)	32.663***	(10.460)	2.750	(2.108)	0.066	11	11	608
	m.a. gap																		
			0.59	(0.07)	4.653	(8.224)	0.001	11	17	586	0.60	(0.08)	13.329	(21.587)	2.134	(2.670)	0.017	9	11
Foreign currency cross border loans / Assets		0.42	(0.06)	-4.1e-03	(3.8e-03)	0.013	11	16	386	0.56	(0.06)	-6.8e-03*	(4.0e-03)	0.438	(2.673)	0.023	9	11	337
	3y growth	0.46	(0.05)	-6.5e-03	(4.3e-03)	0.007	11	17	518	0.55	(0.08)	-4.3e-03	(5.2e-03)	1.616	(2.573)	0.010	9	11	425
	1y growth	0.48	(0.07)	-17.959	(16.084)	0.003	11	16	386	0.50	(0.09)	-3.424	(19.043)	0.565	(2.759)	0.001	9	11	337
	3y difference	0.52	(0.05)	30.028	(27.085)	0.002	11	17	518	0.59	(0.08)	94.275	(60.330)	1.906	(2.638)	0.018	9	11	425
	1y difference																		
Own currency cross border loans / Assets		0.60*	(0.07)	13.661	(11.230)	0.005	11	17	586	0.64**	(0.07)	30.584	(28.435)	1.902	(2.795)	0.024	9	11	469
	3y growth	0.39	(0.06)	-5.4e-03	(4.9e-03)	0.019	11	16	386	0.62	(0.07)	-0.010**	(0.004)	0.728	(2.550)	0.042	9	11	337
	1y growth	0.45	(0.05)	-6.8e-03*	(3.7e-03)	0.010	11	17	518	0.56	(0.08)	-6.5e-03**	(3.2e-03)	1.664	(2.491)	0.015	9	11	425
	3y difference	0.49	(0.06)	-30.979	(26.553)	0.005	11	16	386	0.52	(0.08)	-41.730	(26.423)	0.395	(2.625)	0.008	9	11	337
	1y difference	0.51	(0.05)	18.999	(32.140)	0.001	11	17	518	0.54	(0.09)	11.732	(30.444)	1.687	(2.553)	0.007	9	11	425
(ST liabilities - Liquid assets) / Total assets		0.50	(0.08)	0.061	(1.796)	0.000	10	13	269	0.55	(0.08)	0.766	(2.699)	0.251	(3.004)	0.002	9	11	238
	3y growth	0.59	(0.13)	-5.7e-04	(4.2e-04)	0.013	10	13	113	0.59	(0.09)	-7.8e-04*	(4.1e-04)	-1.669	(2.337)	0.029	9	11	106
	1y growth	0.62*	(0.07)	8.7e-04	(2.0e-03)	0.003	10	13	217	0.66***	(0.06)	0.020**	(0.010)	0.776	(2.108)	0.071	9	11	194
	3y difference	0.73*	(0.10)	17.725**	(8.330)	0.136	10	13	113	0.78**	(0.09)	21.187**	(9.111)	-2.288	(2.824)	0.185	9	11	106
	1y difference	0.62*	(0.07)	9.281	(8.253)	0.023	10	13	217	0.62	(0.07)	16.320**	(6.803)	0.718	(2.104)	0.050	9	11	194
Short-term liabilities / Liquid assets		0.49	(0.07)	0.042	(0.416)	0.000	10	13	269	0.52	(0.08)	0.184	(0.702)	0.176	(3.328)	0.002	9	11	238
	3y growth	0.66	(0.12)	0.048*	(0.028)	0.076	10	13	113	0.74*	(0.11)	0.066**	(0.032)	-3.3					

Table B3. All early-warning evaluation results for each indicator category with Laeven & Valencia (2012) banking crisis dataset. Evaluation horizon is 1 to 3 years. Statistical significance and larger |AUC-0.5| indicates better performance. pR2 is pseudo R2, Cr is the number of crises, Co is the number of countries, N is the number of observations.

Panel A: Measures of credit developments, Laeven & Valencia crisis dataset

Indicator	Transformation	univariate				bivariate				Credit-to-GDP gap									
		AUC	Logit coeff.	pR2	Cr	AUC	Logit coeff.	pR2	Cr	Co	N	Logit coeff.	pR2	Cr	Co	N			
Total credit (real)	3y growth	0.60	(0.07)	0.014	(0.010)	0.017	13	15	1206	0.76***	(0.06)	-0.027***	(0.010)	10.045***	(1.613)	0.131	12	14	1171
	1y growth	0.66***	(0.05)	0.036	(0.032)	0.020	13	15	1302	0.74***	(0.06)	9.6e-04	(1.1e-02)	7.382***	(1.531)	0.115	12	14	1227
	relative gap	0.60	(0.06)	0.024*	(0.013)	0.013	12	14	1122	0.74***	(0.07)	-0.049***	(0.016)	10.498***	(1.943)	0.133	12	14	1122
Total bank credit (real)	3y growth	0.62**	(0.06)	0.014*	(0.008)	0.021	13	15	1187	0.74***	(0.06)	-8.4e-03	(5.7e-03)	8.325***	(1.747)	0.117	12	14	1159
	1y growth	0.68***	(0.05)	0.034	(0.025)	0.020	13	15	1283	0.74***	(0.07)	8.2e-03	(6.9e-03)	7.141***	(1.488)	0.115	12	14	1223
	relative gap	0.60	(0.06)	0.016	(0.012)	0.010	12	14	1103	0.73***	(0.06)	-0.021	(0.014)	8.642***	(2.091)	0.120	12	14	1103
Household credit (real)	3y growth	0.66**	(0.06)	9.1e-03	(6.5e-03)	0.012	12	14	909	0.72***	(0.07)	-2.9e-03	(5.5e-03)	7.024***	(1.554)	0.106	12	14	898
	1y growth	0.63**	(0.06)	0.013	(0.012)	0.003	13	15	1004	0.72***	(0.06)	-7.1e-03	(1.5e-02)	6.875***	(1.537)	0.103	12	14	970
	relative gap	0.58	(0.07)	0.011	(0.019)	0.003	12	14	832	0.69***	(0.06)	-4.9e-03	(2.0e-02)	6.197***	(1.556)	0.081	12	14	832
Corporate credit (real)	3y growth	0.54	(0.08)	6.8e-03	(1.3e-02)	0.003	12	14	909	0.76***	(0.06)	-0.039***	(0.013)	10.442***	(2.078)	0.135	12	14	898
	1y growth	0.66***	(0.05)	0.037	(0.041)	0.024	13	15	1004	0.71***	(0.06)	9.7e-03	(1.3e-02)	6.469***	(1.574)	0.168	12	14	970
	relative gap	0.45	(0.07)	-0.018	(0.031)	0.003	12	14	832	0.76***	(0.05)	-0.106***	(0.029)	10.728***	(2.056)	0.146	12	14	832
Total credit / GDP		0.85***	(0.04)	2.504***	(0.412)	0.274	19	18	2219	0.87***	(0.03)	2.611***	(0.637)	2.928	(2.623)	0.298	17	17	1892
	3y growth	0.51	(0.07)	-1.7e-04	(1.0e-02)	0.000	18	18	2011	0.81***	(0.05)	-0.034	(0.022)	11.833***	(2.183)	0.188	17	17	1892
	1y growth	0.54	(0.06)	0.019	(0.029)	0.002	19	18	2149	0.80***	(0.05)	-0.049	(0.039)	10.703***	(1.811)	0.168	17	17	1892
	3y difference	0.79***	(0.05)	8.256***	(1.437)	0.203	18	18	2011	0.79***	(0.05)	8.927**	(3.611)	-0.876	(4.650)	0.179	17	17	1892
	1y difference	0.80***	(0.06)	18.503***	(3.390)	0.199	19	18	2149	0.80***	(0.06)	18.840***	(6.026)	0.778	(3.244)	0.197	17	17	1892
	trend gap	0.78***	(0.05)	9.770***	(1.781)	0.159	17	17	1892	0.78***	(0.05)	9.770***	(1.781)	0.0e+00	(.)	0.159	17	17	1892
	relative gap	0.65***	(0.05)	0.477**	(0.020)	0.038	17	17	1892	0.82***	(0.06)	-0.080**	(0.038)	15.560***	(2.794)	0.183	17	17	1892
	5y m.a. gap	0.80***	(0.05)	13.241***	(2.265)	0.193	17	17	1892	0.80***	(0.05)	18.532***	(5.385)	-4.587	(4.610)	0.197	17	17	1892
	m.a. gap	0.87***	(0.03)	4.439***	(0.574)	0.307	17	17	1892	0.87***	(0.03)	4.598***	(0.918)	-0.643	(3.014)	0.308	17	17	1892
	1y diff. / 5y m.a.	0.82***	(0.05)	15.848***	(3.082)	0.236	19	18	2159	0.83***	(0.05)	18.983***	(3.785)	-0.860	(2.704)	0.245	17	17	1892
	Total bank credit / GDP		0.84***	(0.04)	4.163***	(0.802)	0.250	19	18	2187	0.86***	(0.04)	3.877***	(1.192)	3.243	(2.505)	0.281	17	17
3y growth		0.53	(0.07)	5.4e-03	(1.1e-02)	0.002	18	18	1979	0.80***	(0.05)	-0.017	(0.014)	10.921***	(1.969)	0.170	17	17	1874
1y growth		0.56	(0.06)	0.025	(0.030)	0.004	19	18	2117	0.78***	(0.05)	-0.022	(0.034)	10.212***	(1.803)	0.161	17	17	1888
3y difference		0.78***	(0.06)	10.659***	(2.203)	0.171	18	18	1979	0.79***	(0.05)	9.023**	(4.551)	1.857	(4.470)	0.180	17	17	1874
1y difference		0.77***	(0.06)	25.955***	(5.256)	0.182	19	18	2117	0.79***	(0.06)	19.173**	(8.563)	3.005	(3.344)	0.187	17	17	1888
trend gap		0.75***	(0.06)	11.121***	(2.317)	0.140	17	17	1860	0.78***	(0.05)	1.678	(3.665)	8.454***	(2.857)	0.158	17	17	1860
relative gap		0.65***	(0.05)	0.044***	(0.016)	0.045	17	17	1860	0.79***	(0.05)	-0.029	(0.024)	12.089***	(2.622)	0.167	17	17	1860
5y m.a. gap		0.79***	(0.06)	16.761***	(3.395)	0.185	17	17	1860	0.79***	(0.06)	15.695**	(7.313)	0.745	(4.665)	0.185	17	17	1860
m.a. gap		0.85***	(0.04)	6.087***	(1.015)	0.265	17	17	1860	0.85***	(0.04)	6.168***	(1.642)	-0.219	(3.292)	0.265	17	17	1860
1y diff. / 5y m.a.		0.81***	(0.05)	22.782***	(5.508)	0.213	19	18	2127	0.81***	(0.06)	20.733***	(7.396)	1.026	(3.350)	0.216	17	17	1888
Total household credit / GDP			0.85***	(0.03)	4.975***	(0.907)	0.231	17	18	1514	0.87***	(0.03)	3.982***	(1.082)	4.803**	(1.991)	0.258	16	17
	3y growth	0.54	(0.06)	-4.3e-04	(3.9e-03)	0.000	16	17	1318	0.78***	(0.06)	-8.2e-03	(9.3e-03)	9.428***	(1.773)	0.158	16	17	1282
	1y growth	0.50	(0.05)	-0.015	(0.014)	0.004	17	18	1452	0.79***	(0.05)	-0.053	(0.035)	9.877***	(1.752)	0.170	16	17	1361
	3y difference	0.83***	(0.05)	17.933***	(2.998)	0.227	16	17	1318	0.83***	(0.05)	18.056***	(5.286)	-0.261	(3.506)	0.222	16	17	1282
	1y difference	0.79***	(0.05)	36.787***	(6.342)	0.153	17	18	1452	0.81***	(0.05)	20.127*	(11.502)	5.089*	(2.888)	0.169	16	17	1361
	trend gap	0.79***	(0.06)	21.211***	(6.086)	0.126	16	17	1206	0.81***	(0.06)	11.664	(7.212)	5.231**	(2.300)	0.147	16	17	1206
	relative gap	0.65**	(0.05)	0.029*	(0.015)	0.020	16	17	1206	0.76***	(0.06)	-5.3e-03	(2.0e-02)	8.852***	(1.946)	0.131	16	17	1206
	5y m.a. gap	0.82***	(0.05)	27.008***	(5.012)	0.194	16	17	1206	0.82***	(0.05)	27.665***	(8.826)	-0.319	(3.557)	0.194	16	17	1206
	m.a. gap	0.84***	(0.03)	8.825***	(1.304)	0.213	16	17	1206	0.85***	(0.03)	7.297***	(1.276)	3.469	(2.327)	0.228	16	17	1206
	1y diff. / 5y m.a.	0.83***	(0.04)	35.203***	(5.345)	0.214	17	18	1454	0.83***	(0.05)	27.821***	(7.885)	2.691	(2.778)	0.210	16	17	1361
	Total corporate credit / GDP		0.86***	(0.03)	4.060***	(0.807)	0.256	17	18	1490	0.87***	(0.03)	3.392***	(0.889)	4.386*	(2.485)	0.255	16	17
3y growth		0.49	(0.07)	-7.8e-04	(1.1e-02)	0.000	16	17	1294	0.81***	(0.06)	-0.044*	(0.024)	12.325***	(2.341)	0.195	16	17	1265
1y growth		0.57	(0.05)	0.033	(0.023)	0.010	17	18	1428	0.79***	(0.05)	-0.027	(0.024)	9.656***	(1.770)	0.154	16	17	1352
3y difference		0.66**	(0.07)	7.583***	(2.554)	0.078	16	17	1294	0.77***	(0.05)	-5.798	(4.589)	13.019***	(3.494)	0.160	16	17	1265
1y difference		0.75***	(0.05)	21.696***	(4.797)	0.149	17	18	1428	0.78***	(0.06)	11.652*	(6.084)	5.675**	(2.491)	0.166	16	17	1352
trend gap		0.64**	(0.07)	8.319**	(3.627)	0.045	16	17	1182	0.80***	(0.05)	-16.260***	(3.895)	16.883***	(3.449)	0.164	16	17	1182
relative gap		0.59	(0.06)	0.045*	(0.024)	0.024	16	17	1182	0.80***	(0.05)	-0.091***	(0.031)	14.244***	(3.192)	0.161	16	17	1182
5y m.a. gap		0.67***	(0.06)	11.946***	(3.650)	0.085	16	17	1182	0.76***	(0.05)	-2.775	(6.394)	9.799***	(3.632)	0.129	16	17	1182
m.a. gap		0.80***	(0.04)	5.536***	(1.200)	0.154	16	17	1182	0.81***	(0.05)	4.064***	(1.167)	4.631*	(2.601)	0.183	16	17	1182
1y diff. / 5y m.a.		0.81***	(0.04)	23.338***	(3.354)	0.216	17	18	1430	0.81***	(0.05)	18.338***	(3.298)	3.307	(2.352)	0.206	16	17	1352

Robust standard errors adjusted for clustering are reported in the parentheses. **, * and *** indicate statistical significance at the 10%, 5% and 1%-level.

Panel B: Measures of private sector debt burden, Laeven & Valencia crisis dataset

Indicator	Transformation	univariate						bivariate											
		AUC	Indicator Logit coeff.	pR2	Cr	Co	N	AUC	Indicator Logit coeff.	Credit-to-GDP gap Logit coeff.	pR2	Cr	Co	N					
Household credit / Gross disposable income		0.63*	(0.05)	3.2e-04***	(5.7e-05)	0.011	12	11	1184	0.81***	(0.06)	2.4e-04***	(7.2e-05)	9.754***	(2.052)	0.198	12	11	1182
	3y growth	0.79***	(0.06)	0.075***	(0.016)	0.159	12	11	1057	0.82***	(0.07)	0.041**	(0.019)	7.417***	(2.239)	0.220	12	11	1057
	1y growth	0.68***	(0.06)	0.130***	(0.036)	0.062	12	11	1144	0.80***	(0.07)	0.031	(0.042)	9.305***	(1.978)	0.195	12	11	1144
	3y difference	0.70*	(0.08)	1.3e-03***	(2.3e-04)	0.010	12	11	1057	0.80***	(0.07)	8.4e-04***	(3.1e-04)	9.733***	(2.185)	0.196	12	11	1057
	1y difference	0.66*	(0.07)	2.8e-03***	(5.6e-04)	0.005	12	11	1144	0.80***	(0.06)	1.5e-03***	(7.6e-04)	9.806***	(2.072)	0.193	12	11	1144
	trend gap	0.72**	(0.08)	2.1e-03***	(3.1e-04)	0.010	12	11	980	0.79***	(0.07)	1.2e-03**	(4.9e-04)	9.192***	(2.354)	0.166	12	11	980
	relative gap	0.74***	(0.06)	0.087***	(0.023)	0.101	12	11	980	0.81**	(0.07)	0.049*	(0.027)	7.585***	(2.201)	0.184	12	11	980
	5y m.a. gap	0.70*	(0.08)	1.9e-03***	(3.3e-04)	0.009	12	11	980	0.79***	(0.07)	1.2e-03**	(5.0e-04)	9.227***	(2.338)	0.166	12	11	980
	m.a. gap	0.74***	(0.06)	7.5e-04***	(9.4e-05)	0.018	12	11	980	0.79***	(0.07)	5.4e-04***	(1.4e-04)	9.125***	(2.373)	0.172	12	11	980
	Debt-service-ratio (BIS)		0.73***	(0.06)	0.065	(0.045)	0.032	13	12	1420	0.77***	(0.06)	0.028	(0.037)	8.154***	(2.233)	0.124	13	12
3y growth		0.61*	(0.06)	0.026*	(0.015)	0.025	13	12	1281	0.75***	(0.06)	1.6e-03	(1.4e-02)	8.308***	(2.303)	0.115	13	12	1267
1y growth		0.72***	(0.05)	0.103***	(0.033)	0.071	13	12	1376	0.76***	(0.06)	0.070***	(0.025)	7.346***	(1.955)	0.145	13	12	1346
3y difference		0.63*	(0.06)	0.207**	(0.087)	0.047	13	12	1281	0.75***	(0.06)	0.059	(0.067)	7.610***	(2.266)	0.118	13	12	1267
1y difference		0.74***	(0.05)	0.574***	(0.202)	0.092	13	12	1376	0.78***	(0.06)	0.366***	(0.109)	6.901***	(1.901)	0.153	13	12	1346
trend gap		0.70***	(0.07)	0.228*	(0.125)	0.058	13	12	1197	0.75***	(0.06)	0.019	(0.140)	7.784**	(3.116)	0.111	13	12	1197
relative gap		0.69***	(0.07)	0.044*	(0.023)	0.051	13	12	1197	0.74***	(0.06)	-4.4e-03	(3.0e-02)	8.516**	(3.365)	0.111	13	12	1197
5y m.a. gap		0.68**	(0.06)	0.420***	(0.137)	0.078	13	12	1197	0.74***	(0.06)	0.214*	(0.117)	6.315***	(2.129)	0.125	13	12	1197
m.a. gap		0.70***	(0.06)	0.211***	(0.075)	0.073	13	12	1197	0.76***	(0.06)	0.130***	(0.044)	7.036***	(2.117)	0.141	13	12	1197
Debt-service-ratio (ESRB)			0.69***	(0.05)	2.586***	(0.750)	0.031	21	25	2295	0.78***	(0.04)	2.475***	(0.428)	8.813***	(1.674)	0.171	17	16
	3y growth	0.65***	(0.05)	9.6e-03*	(5.2e-03)	0.013	20	24	2021	0.76***	(0.05)	0.018	(0.011)	7.741***	(1.639)	0.150	17	16	1534
	1y growth	0.71***	(0.04)	0.028*	(0.014)	0.020	20	25	2209	0.78***	(0.05)	0.073***	(0.024)	7.526***	(1.697)	0.170	17	16	1574
	3y difference	0.69***	(0.05)	17.094***	(6.183)	0.058	20	24	2021	0.76***	(0.05)	7.387**	(2.868)	7.802***	(1.689)	0.153	17	16	1534
	1y difference	0.78***	(0.04)	50.550***	(14.729)	0.098	20	25	2209	0.80***	(0.05)	34.875***	(9.792)	7.218***	(1.760)	0.190	17	16	1574
	trend gap	0.64***	(0.04)	20.771***	(4.897)	0.048	18	21	1867	0.75***	(0.05)	1.884	(7.050)	8.027***	(1.841)	0.123	16	15	1499
	relative gap	0.60*	(0.05)	0.012	(0.011)	0.006	18	21	1867	0.79***	(0.06)	-0.047***	(0.015)	11.903***	(2.169)	0.143	16	15	1499
	5y m.a. gap	0.71***	(0.05)	28.981***	(9.967)	0.072	18	21	1867	0.76***	(0.05)	16.700***	(5.399)	6.677***	(1.629)	0.142	16	15	1499
	m.a. gap	0.77***	(0.05)	17.803***	(4.421)	0.118	18	21	1867	0.82***	(0.05)	15.061***	(3.806)	6.226***	(1.700)	0.202	16	15	1499
	Corporate debt-service-ratio (ESRB)		0.67***	(0.06)	4.523***	(1.120)	0.076	16	24	1104	0.77***	(0.07)	2.366*	(1.270)	6.277***	(2.119)	0.140	13	15
3y growth		0.65**	(0.07)	0.025**	(0.013)	0.045	14	21	837	0.73***	(0.07)	0.013	(0.013)	6.033***	(2.104)	0.133	13	15	779
1y growth		0.74***	(0.04)	0.072***	(0.021)	0.082	16	24	1016	0.76***	(0.06)	0.075***	(0.019)	5.357**	(2.081)	0.173	13	15	882
3y difference		0.67***	(0.07)	11.302***	(4.937)	0.069	14	21	837	0.73***	(0.07)	3.971	(5.524)	5.980**	(2.470)	0.133	13	15	779
1y difference		0.76***	(0.04)	23.023***	(7.714)	0.098	16	24	1016	0.78***	(0.06)	27.334***	(6.705)	4.363*	(2.278)	0.189	13	15	882
trend gap		0.58	(0.08)	8.608	(7.984)	0.020	13	19	706	0.75***	(0.07)	-7.457	(8.050)	8.202***	(2.907)	0.115	13	15	684
relative gap		0.55	(0.08)	0.014	(0.020)	0.006	13	19	706	0.75***	(0.07)	-0.032	(0.022)	8.478***	(2.666)	0.123	13	15	684
5y m.a. gap		0.70***	(0.07)	19.628**	(7.890)	0.089	13	19	706	0.72***	(0.07)	11.505	(8.909)	4.325*	(2.572)	0.122	13	15	684
m.a. gap		0.78***	(0.07)	13.345***	(4.945)	0.146	13	19	706	0.78***	(0.07)	10.781**	(4.886)	3.075	(2.416)	0.169	13	15	684
Household debt-service-ratio (ESRB)			0.74***	(0.06)	18.738***	(4.355)	0.124	16	24	1092	0.80***	(0.05)	17.541***	(5.008)	3.747	(2.401)	0.197	13	15
	3y growth	0.69***	(0.06)	6.8e-03	(5.0e-03)	0.012	14	21	825	0.75**	(0.07)	0.011*	(0.006)	6.703***	(2.236)	0.141	13	15	767
	1y growth	0.70***	(0.05)	0.030**	(0.015)	0.024	16	24	1004	0.75***	(0.07)	0.040*	(0.021)	6.928***	(2.184)	0.147	13	15	870
	3y difference	0.76***	(0.06)	47.491***	(11.635)	0.146	14	21	825	0.79***	(0.06)	46.355***	(13.434)	3.342	(2.958)	0.205	13	15	767
	1y difference	0.77***	(0.04)	92.462***	(21.099)	0.126	16	24	1004	0.80***	(0.06)	91.074***	(23.141)	4.351*	(2.531)	0.200	13	15	870
	trend gap	0.75***	(0.06)	79.602***	(21.125)	0.123	13	19	694	0.77***	(0.07)	58.535***	(22.232)	4.756*	(2.577)	0.154	13	15	672
	relative gap	0.70**	(0.07)	0.035*	(0.020)	0.040	13	19	694	0.73**	(0.08)	0.023	(0.017)	6.276***	(2.333)	0.121	13	15	672
	5y m.a. gap	0.79***	(0.06)	90.167***	(24.300)	0.185	13	19	694	0.80***	(0.06)	80.166***	(25.548)	2.881	(3.024)	0.207	13	15	672
	m.a. gap	0.79***	(0.07)	56.466***	(15.197)	0.229	13	19	694	0.79***	(0.07)	51.951***	(15.054)	1.595	(2.679)	0.239	13	15	672
	Household credit * 10y interest rate / GDP		0.54	(0.06)	0.107	(0.159)	0.004	15	19	1042	0.75***	(0.06)	6.7e-04	(1.6e-01)	7.590***	(1.676)	0.134	15	17
3y growth		0.66***	(0.04)	9.7e-03**	(4.1e-03)	0.021	14	17	835	0.73***	(0.06)	3.8e-03	(3.7e-03)	6.631***	(1.719)	0.126	14	17	835
1y growth		0.67***	(0.03)	0.023***	(0.006)	0.036	15	19	970	0.75***	(0.05)	0.022***	(0.005)	7.039***	(1.761)	0.156	15	17	960
3y difference		0.67***	(0.04)	0.863***	(0.231)	0.055	14	17	835	0.74***	(0.06)	0.389**	(0.190)	6.073***	(1.828)	0.132	14	17	835
1y difference		0.69***	(0.02)	1.209***	(0.247)	0.057	15	19	970	0.76***	(0.05)	0.998***	(0.235)	6.684***	(1.733)	0.161	15	17	960
trend gap		0.64**	(0.06)	0.965**	(0.476)	0.036	14	17	726	0.72***	(0.06)	0.654	(0.504)	5.722***	(1.739)	0.115	14	17	726
relative gap		0.62*	(0.07)	5.5e-03	(9.3e-03)	0.006	14	17	726	0.72***	(0.06)	4.7e-03	(9.1e-03)	6.268***	(1.744)	0.105	14	17	726
5y m.a. gap		0.71***	(0.04)	1.852***	(0.436)	0.091	14	17	726	0.74***	(0.05)	1.277***	(0.381)	4.808**	(1.949)	0.135	14	17	726
m.a. gap		0.62*	(0.06)	0.624**	(0.292)	0.036	14	17	726	0.72***	(0.06)	0.225	(0.284)	5.838***	(1.897)	0.105	14	17	726
Household credit * 3m interest rate / GDP			0.58	(0.06)	0.083	(0.096)	0.003	16	24	1422	0.75***	(0.05)	-0.046	(0.114)	7.866***	(1.683)	0.131	15	17
	3y growth	0.75***	(0.04)	4.6e-03*	(2.4e-03)	0.040	16	24	1152	0.81***	(0.04)	0.014***	(0.004)	6.110***	(2.064)	0.223	15	17	1026
	1y growth	0.80***	(0.03)	0.024***	(0.006)	0.120	16	24	1334	0.86***	(0.03)	0.036***	(0.007)	7.045***	(2.067)	0.278	15	17	1144
	3y difference	0.77***	(0.03)	0.816***	(0.186)	0.124	16	24	1152	0.81***	(0.04)	0.740***	(0.246)	5.976***	(1.846)	0.206	15	17	1026
	1y difference	0.82***	(0.03)	1.428***	(0.360)	0.138	16	24	1334	0.84***	(0.04)	1.205***	(0.382)	7.104***	(1.939)	0.226	15	17	1144
	trend gap	0.80***	(0.03)	1.414***	(0.276)	0.158	16	24	990	0.80***	(0.04)	1.220***	(0.262)	5.6					

Panel C: Measures of potential overvaluation of property prices, Laeven & Valencia crisis dataset

Indicator	Transformation	univariate						bivariate			Credit-to-GDP gap								
		AUC	Indicator Logit coeff.	pR2	Cr	Co	N	AUC	Indicator Logit coeff.	Logit coeff.	pR2	Cr	Co	N					
Residential property real price	3y growth	0.70***	(0.06)	0.017***	(0.007)	0.034	17	17	1548	0.78***	(0.06)	0.014	(0.012)	7.928***	(1.634)	0.155	16	14	1442
	1y growth	0.61**	(0.05)	0.022**	(0.011)	0.010	17	18	1688	0.77***	(0.05)	0.019	(0.018)	8.560***	(1.688)	0.148	16	15	1486
	relative gap	0.73***	(0.06)	0.047***	(0.018)	0.078	17	17	1429	0.80***	(0.06)	0.033*	(0.020)	7.472***	(1.629)	0.182	16	14	1403
Residential property price / rent	3y growth	0.79***	(0.07)	0.027*	(0.014)	0.099	19	20	1609	0.78***	(0.07)	0.018*	(0.010)	7.245***	(1.444)	0.174	16	15	1503
	1y growth	0.69***	(0.06)	0.013**	(0.006)	0.024	16	17	1398	0.78***	(0.06)	0.014	(0.013)	7.928***	(1.755)	0.160	15	14	1340
	3y difference	0.62**	(0.05)	0.020*	(0.011)	0.009	17	18	1531	0.78***	(0.06)	0.022	(0.019)	8.765***	(1.755)	0.158	16	15	1449
	1y difference	0.72***	(0.06)	0.040***	(0.014)	0.071	16	17	1398	0.79***	(0.06)	0.029	(0.021)	7.347***	(1.698)	0.171	15	14	1340
	trend gap	0.65**	(0.06)	0.051**	(0.025)	0.028	17	18	1531	0.79***	(0.06)	0.039	(0.029)	8.622***	(1.680)	0.162	16	15	1449
	relative gap	0.74***	(0.06)	0.073**	(0.032)	0.097	16	17	1286	0.80***	(0.06)	0.044	(0.032)	6.824***	(1.811)	0.173	15	14	1249
	5y m.a. gap	0.69***	(0.06)	0.036**	(0.016)	0.048	16	17	1286	0.78***	(0.06)	0.024	(0.018)	7.516***	(1.678)	0.161	15	14	1249
	m.a. gap	0.73***	(0.06)	0.066**	(0.026)	0.078	16	17	1286	0.79***	(0.06)	0.044	(0.033)	7.243***	(1.716)	0.166	15	14	1249
	m.a. gap	0.79***	(0.06)	0.045***	(0.015)	0.155	16	17	1286	0.81***	(0.06)	0.026	(0.022)	5.140*	(2.629)	0.171	15	14	1249
Residential property price / income	3y growth	0.80***	(0.06)	0.029**	(0.015)	0.102	19	21	1596	0.79***	(0.07)	0.022*	(0.013)	7.383***	(1.496)	0.183	16	15	1450
	1y growth	0.73***	(0.06)	0.034***	(0.012)	0.067	16	18	1373	0.79***	(0.06)	0.034**	(0.017)	6.982***	(1.703)	0.184	15	14	1285
	3y difference	0.65***	(0.04)	0.044***	(0.012)	0.025	17	19	1514	0.77***	(0.06)	0.042*	(0.022)	8.379***	(1.790)	0.162	16	15	1394
	1y difference	0.75***	(0.06)	0.057***	(0.019)	0.111	16	18	1373	0.80***	(0.07)	0.062**	(0.026)	5.903***	(1.646)	0.208	15	14	1285
	trend gap	0.67***	(0.04)	0.075***	(0.016)	0.053	17	19	1514	0.78***	(0.06)	0.067***	(0.024)	8.034***	(1.791)	0.170	16	15	1394
	relative gap	0.75***	(0.07)	0.108***	(0.033)	0.138	16	18	1254	0.79***	(0.07)	0.075**	(0.038)	5.952***	(1.691)	0.198	15	14	1194
	5y m.a. gap	0.71***	(0.07)	0.062***	(0.022)	0.081	16	18	1254	0.78***	(0.07)	0.044*	(0.026)	6.989***	(1.634)	0.177	15	14	1194
	m.a. gap	0.76***	(0.06)	0.103***	(0.033)	0.134	16	18	1254	0.80***	(0.06)	0.091**	(0.036)	5.897***	(1.652)	0.202	15	14	1194
	m.a. gap	0.80***	(0.06)	0.065***	(0.019)	0.212	16	18	1254	0.81***	(0.06)	0.059**	(0.026)	2.721	(2.327)	0.223	15	14	1194

Robust standard errors adjusted for clustering are reported in the parentheses. *, ** and *** indicate statistical significance at the 10 %, 5 % and 1 %-level.

Panel D: Measures of external imbalances, Laeven & Valencia crisis dataset

Indicator	Transformation	univariate						bivariate			Credit-to-GDP gap								
		AUC	Indicator Logit coeff.	pR2	Cr	Co	N	AUC	Indicator Logit coeff.	Logit coeff.	pR2	Cr	Co	N					
Current account / GDP	3y growth	0.46	(0.05)	-0.118	(0.111)	0.006	20	25	1897	0.78***	(0.05)	0.051	(0.210)	8.787***	(1.724)	0.146	16	17	1346
	1y growth	0.58*	(0.04)	8.5e-06	(3.9e-05)	0.000	20	25	1606	0.77***	(0.05)	3.4e-06	(1.2e-05)	8.214***	(1.581)	0.141	16	17	1202
	3y difference	0.55	(0.03)	-3.7e-06	(1.2e-05)	0.000	20	25	1804	0.77***	(0.05)	-4.0e-06	(1.2e-05)	8.507***	(1.626)	0.144	16	17	1304
	1y difference	0.39**	(0.05)	-0.293**	(0.133)	0.019	20	25	1606	0.77***	(0.05)	-0.196	(0.227)	7.783***	(1.608)	0.143	16	17	1202
Capital account / GDP	3y growth	0.41***	(0.03)	-0.394***	(0.135)	0.019	20	25	1804	0.77***	(0.05)	-0.244	(0.223)	8.334***	(1.549)	0.146	16	17	1304
	1y growth	0.49	(0.05)	-58.774	(77.612)	0.002	17	21	1048	0.74***	(0.05)	-131.467	(115.228)	7.246***	(1.353)	0.113	15	17	923
	3y difference	0.50	(0.03)	2.3e-05	(4.0e-05)	0.000	15	20	742	0.71***	(0.04)	2.6e-05	(4.9e-05)	6.006***	(1.235)	0.098	14	17	674
	1y difference	0.46*	(0.03)	-1.1e-05	(7.3e-05)	0.000	16	21	905	0.71***	(0.04)	-7.5e-05	(7.3e-05)	6.307***	(1.287)	0.103	14	17	802
Portfolio investments / GDP	3y growth	0.49	(0.05)	-7.608	(64.786)	0.000	16	20	803	0.73***	(0.05)	86.954	(156.462)	6.488***	(1.312)	0.110	15	17	733
	1y growth	0.49	(0.03)	-75.068***	(20.140)	0.004	17	21	966	0.72***	(0.05)	-8.929	(55.291)	6.533***	(1.319)	0.105	15	17	861
	3y difference	0.43	(0.07)	-0.483	(0.389)	0.010	17	21	609	0.71**	(0.07)	-0.141	(0.990)	5.804***	(2.124)	0.098	15	17	520
	1y difference	0.52	(0.06)	4.2e-05	(1.7e-04)	0.000	14	19	361	0.73***	(0.07)	2.2e-03	(1.4e-03)	6.022**	(2.559)	0.091	12	15	322
Other investments / GDP	3y growth	0.48	(0.04)	-6.6e-05	(1.5e-04)	0.000	17	21	524	0.73**	(0.08)	-1.0e-06	(2.0e-04)	6.076**	(2.414)	0.107	15	17	453
	1y growth	0.38	(0.07)	-1.619	(1.077)	0.036	14	19	361	0.70**	(0.08)	-1.502*	(0.875)	5.817**	(2.851)	0.087	12	15	322
	3y difference	0.44	(0.05)	-0.996***	(0.374)	0.010	17	21	524	0.73**	(0.08)	-1.252	(0.889)	5.956**	(2.433)	0.110	15	17	453
	1y difference	0.43	(0.07)	-0.483	(0.389)	0.010	17	21	609	0.71**	(0.07)	-0.141	(0.990)	5.804***	(2.124)	0.098	15	17	520
Other investments / GDP	3y growth	0.52	(0.06)	4.2e-05	(1.7e-04)	0.000	14	19	361	0.73***	(0.08)	2.2e-03	(1.4e-03)	6.022**	(2.559)	0.091	12	15	322
	1y growth	0.48	(0.04)	-6.6e-05	(1.5e-04)	0.000	17	21	524	0.73***	(0.08)	-1.0e-06	(2.0e-04)	6.076**	(2.414)	0.107	15	17	453
	3y difference	0.38*	(0.07)	-1.619	(1.077)	0.036	14	19	361	0.70**	(0.08)	-1.502*	(0.875)	5.817**	(2.851)	0.087	12	15	322
	1y difference	0.44	(0.05)	-0.996***	(0.374)	0.010	17	21	524	0.73***	(0.07)	-1.252	(0.889)	5.956**	(2.433)	0.110	15	17	453

Robust standard errors adjusted for clustering are reported in the parentheses. *, ** and *** indicate statistical significance at the 10 %, 5 % and 1 %-level.

Panel E: Measures of potential mispricing of risk, Laeven & Valencia crisis dataset

Indicator	Transformation	univariate					bivariate					Credit-to-GDP gap							
		AUC	Indicator	Logit coeff.	pR2	Cr	Co	N	AUC	Indicator	Logit coeff.	Logit coeff.	pR2	Cr	Co	N			
Stock market volatility		0.39***	(0.04)	-5.231**	(2.191)	0.022	21	27	2308	0.80***	(0.05)	-8.011**	(3.264)	10.074***	(1.941)	0.194	16	17	1705
	3y growth	0.42**	(0.03)	-5.0e-03**	(2.0e-03)	0.013	20	27	2003	0.80***	(0.05)	-7.5e-03***	(2.9e-03)	9.544***	(1.797)	0.184	16	17	1618
	1y growth	0.55*	(0.02)	5.4e-04	(1.0e-03)	0.000	21	27	2206	0.79***	(0.05)	1.6e-03*	(9.2e-04)	9.633***	(1.826)	0.165	16	17	1685
	3y difference	0.43**	(0.03)	-2.338***	(0.870)	0.013	20	27	2004	0.80***	(0.05)	-4.460***	(1.511)	9.626***	(1.789)	0.190	16	17	1618
	1y difference	0.54	(0.02)	-0.139	(0.831)	0.000	21	27	2207	0.79***	(0.05)	1.016	(0.886)	9.614***	(1.820)	0.164	16	17	1685
Stock market index	3y growth	0.72***	(0.04)	5.7e-03**	(2.5e-03)	0.028	14	14	1000	0.80***	(0.05)	9.7e-03***	(3.1e-03)	9.407***	(1.757)	0.212	14	13	949
	1y growth	0.68***	(0.03)	8.3e-03**	(3.9e-03)	0.013	14	14	1112	0.79***	(0.05)	0.014*	(0.007)	9.220***	(1.628)	0.184	14	13	1045
Bank stock index	3y growth	0.71***	(0.04)	5.9e-03***	(2.2e-03)	0.028	13	13	1081	0.79***	(0.05)	9.2e-03***	(1.9e-03)	8.504***	(1.863)	0.182	13	13	1081
	1y growth	0.61***	(0.04)	4.4e-03	(3.4e-03)	0.003	14	13	1183	0.75***	(0.05)	9.9e-03***	(2.7e-03)	8.239***	(1.715)	0.146	14	13	1183
Stock market P/E ratio		0.43	(0.04)	-0.030**	(0.013)	0.024	15	22	774	0.70***	(0.06)	-0.039**	(0.019)	5.671***	(1.997)	0.112	13	16	664
	3y growth	0.32***	(0.07)	-0.010***	(0.004)	0.104	14	21	513	0.74***	(0.05)	-0.011**	(0.005)	5.072***	(1.644)	0.163	13	16	481
	1y growth	0.52	(0.02)	-2.7e-03**	(7.1e-04)	0.012	15	22	686	0.68***	(0.06)	-3.0e-03**	(1.3e-03)	5.327***	(1.897)	0.092	13	16	604
	3y difference	0.32**	(0.07)	-4.3e-03*	(2.5e-03)	0.030	14	21	513	0.70***	(0.06)	-4.8e-03	(3.2e-03)	4.992***	(1.880)	0.102	13	16	481
	1y difference	0.52	(0.02)	-2.3e-04**	(1.1e-04)	0.000	15	22	686	0.67**	(0.07)	-2.8e-04***	(1.0e-04)	5.270***	(1.926)	0.081	13	16	604
Stock market P/B ratio		0.50	(0.15)	-0.015	(0.442)	0.000	13	14	135	0.60	(0.14)	-0.157	(0.508)	1.892	(1.598)	0.014	13	14	135
	1y growth	0.68***	(0.03)	0.058***	(0.013)	0.142	13	14	79	0.72***	(0.05)	0.066***	(0.011)	2.443	(1.810)	0.166	13	14	79
	1y difference	0.67***	(0.03)	2.254***	(0.499)	0.136	13	14	79	0.70***	(0.05)	2.544***	(0.451)	2.244	(1.805)	0.156	13	14	79
Stock market dividend yield		0.44	(0.05)	-0.362	(0.233)	0.014	13	14	361	0.58	(0.07)	-0.379	(0.250)	2.977*	(1.525)	0.042	13	14	361
	3y growth	0.28***	(0.07)	-0.033***	(0.012)	0.131	13	14	193	0.76***	(0.07)	-0.035***	(0.012)	3.529**	(1.638)	0.171	13	14	193
	1y growth	0.48	(0.04)	-0.012**	(0.006)	0.015	13	14	305	0.61*	(0.06)	-0.013**	(0.006)	2.955**	(1.471)	0.044	13	14	305
	3y difference	0.28***	(0.06)	-1.150***	(0.416)	0.120	13	14	193	0.75***	(0.07)	-1.236***	(0.421)	3.409**	(1.564)	0.160	13	14	193
	1y difference	0.48	(0.04)	-0.232	(0.154)	0.004	13	14	305	0.59	(0.06)	-0.265*	(0.159)	2.924*	(1.500)	0.033	13	14	305
Household lending spread		0.35*	(0.08)	-0.224	(0.280)	0.012	17	26	449	0.75***	(0.07)	-0.806	(0.801)	2.917*	(1.747)	0.107	14	17	320
	3y growth	0.32*	(0.10)	-0.018*	(0.010)	0.103	14	19	147	0.83***	(0.08)	-0.027*	(0.015)	4.742	(2.941)	0.209	12	15	120
	1y growth	0.39*	(0.06)	-1.2e-03	(1.9e-03)	0.002	17	26	345	0.72***	(0.06)	-0.029*	(0.016)	4.798***	(1.790)	0.123	14	17	252
	3y difference	0.29*	(0.10)	-0.923*	(0.512)	0.113	14	19	147	0.84***	(0.07)	-1.193	(0.794)	4.456*	(2.603)	0.200	12	15	120
	1y difference	0.42	(0.05)	-0.152	(0.215)	0.003	17	26	345	0.66***	(0.06)	-0.493	(0.662)	3.915**	(1.601)	0.060	14	17	252
Corporate lending spread		0.33***	(0.06)	-0.935***	(0.358)	0.067	16	25	438	0.70***	(0.07)	-1.084**	(0.463)	4.288**	(1.843)	0.103	13	16	309
	3y growth	0.32	(0.13)	-0.036	(0.022)	0.102	14	19	147	0.78**	(0.11)	-0.059**	(0.027)	3.700	(2.517)	0.221	12	15	120
	1y growth	0.51	(0.05)	-1.7e-04	(6.3e-03)	0.000	16	25	338	0.62**	(0.07)	-4.9e-03	(1.1e-02)	3.635**	(1.668)	0.046	13	16	245
	3y difference	0.30*	(0.12)	-1.756	(1.397)	0.095	14	19	147	0.80***	(0.10)	-4.006***	(1.525)	3.270	(2.353)	0.252	12	15	120
	1y difference	0.51	(0.05)	0.159	(0.303)	0.001	16	25	338	0.62*	(0.06)	-0.214	(0.514)	3.580**	(1.628)	0.046	13	16	245
High-yield spread		0.09***	(0.01)	-0.016***	(0.001)	0.386	17	27	1031	0.93***	(0.01)	-0.020***	(0.002)	5.383**	(2.144)	0.503	14	17	620
	3y growth	0.39***	(0.02)	-0.013***	(0.001)	0.092	17	27	729	0.74***	(0.05)	-0.014***	(0.001)	4.709***	(1.719)	0.150	14	17	431
	1y growth	0.46***	(0.01)	-6.1e-03***	(2.3e-04)	0.020	17	27	934	0.66**	(0.06)	-5.8e-03***	(6.5e-04)	4.526**	(1.764)	0.073	14	17	564
	3y difference	0.42***	(0.02)	-5.6e-04***	(1.0e-04)	0.014	17	27	729	0.66**	(0.07)	-5.8e-04***	(2.0e-04)	4.348**	(1.699)	0.066	14	17	431
	1y difference	0.52**	(0.01)	-8.1e-05	(5.1e-05)	0.000	17	27	934	0.64**	(0.07)	1.2e-06	(1.2e-04)	4.501**	(1.793)	0.058	14	17	564
	trend gap	0.63***	(0.05)	3.1e-04	(3.4e-04)	0.002	17	27	545	0.74***	(0.04)	1.6e-03	(2.0e-03)	3.906**	(1.796)	0.087	14	17	312
	relative gap	0.61***	(0.05)	-2.9e-03***	(1.1e-03)	0.007	17	27	545	0.64**	(0.06)	-1.3e-04	(3.9e-03)	4.263**	(1.708)	0.059	14	17	312
	5y m.a. gap	0.64***	(0.05)	3.3e-04	(3.4e-04)	0.002	17	27	545	0.75***	(0.04)	1.6e-03	(2.1e-03)	3.849**	(1.845)	0.090	14	17	312
	m.a. gap	0.57**	(0.04)	-2.1e-03***	(3.6e-04)	0.030	17	27	545	0.67**	(0.08)	-1.5e-03	(1.0e-03)	4.535**	(1.762)	0.073	14	17	312
	CBOE Volatility Index		0.19***	(0.03)	-0.232***	(0.051)	0.177	30	27	2175	0.91***	(0.03)	-0.368***	(0.109)	11.278***	(3.295)	0.403	16	17
3y growth		0.18***	(0.03)	-0.043***	(0.008)	0.205	29	27	1853	0.92***	(0.02)	-0.074***	(0.010)	8.683***	(2.375)	0.432	16	17	1086
1y growth		0.39***	(0.02)	-0.015***	(0.003)	0.019	30	27	2067	0.76***	(0.05)	-0.016***	(0.003)	7.917***	(1.680)	0.149	16	17	1198
3y difference		0.20***	(0.02)	-0.149***	(0.021)	0.193	29	27	1853	0.91***	(0.02)	-0.229***	(0.026)	8.485***	(2.109)	0.421	16	17	1086
1y difference		0.39***	(0.02)	-0.042***	(0.010)	0.010	30	27	2067	0.76***	(0.05)	-0.040***	(0.016)	7.944***	(1.687)	0.139	16	17	1198
trend gap		0.16***	(0.03)	-0.233***	(0.045)	0.236	24	27	1682	0.94***	(0.01)	-0.430***	(0.030)	5.935***	(1.978)	0.500	14	17	994
relative gap		0.15***	(0.04)	-0.052***	(0.013)	0.251	24	27	1682	0.96***	(0.01)	-0.141***	(0.010)	5.850***	(2.162)	0.574	14	17	994
5y m.a. gap		0.22***	(0.03)	-0.195***	(0.027)	0.144	24	27	1682	0.88***	(0.03)	-0.253***	(0.021)	6.929***	(1.712)	0.298	14	17	994
m.a. gap		0.11***	(0.02)	-0.628***	(0.205)	0.319	24	27	1682	0.95***	(0.01)	-1.412***	(0.127)	9.874***	(3.544)	0.537	14	17	994

continues on next page...

German 10y Bund		0.30*** (0.05)	-0.424*** (0.117)	0.071 31 27 3961	0.85*** (0.04)	-0.753** (0.383)	6.199*** (2.071)	0.263 17 17 1892
3y growth	0.54 (0.03)	1.4e-03 (4.3e-03)	0.000 31 27 3637	0.78*** (0.05)	3.6e-04 (5.4e-03)	9.773*** (1.782)	0.159 17 17 1892	
1y growth	0.62*** (0.03)	0.024*** (0.005)	0.019 31 27 3853	0.78*** (0.05)	0.030*** (0.007)	9.964*** (1.879)	0.186 17 17 1892	
3y difference	0.57* (0.04)	0.073 (0.059)	0.003 31 27 3637	0.78*** (0.05)	0.108* (0.065)	9.771*** (1.770)	0.163 17 17 1892	
1y difference	0.61*** (0.03)	0.291*** (0.082)	0.013 31 27 3853	0.78*** (0.05)	0.401*** (0.120)	9.820*** (1.807)	0.177 17 17 1892	
trend gap	0.64*** (0.03)	0.313*** (0.084)	0.017 31 27 3448	0.77*** (0.05)	0.326*** (0.102)	9.845*** (1.787)	0.172 17 17 1892	
relative gap	0.63*** (0.03)	0.025*** (0.006)	0.021 31 27 3448	0.77*** (0.05)	0.028*** (0.007)	10.017*** (1.822)	0.179 17 17 1892	
5y m.a. gap	0.61*** (0.03)	0.233** (0.093)	0.011 31 27 3448	0.78*** (0.05)	0.263** (0.105)	9.779*** (1.770)	0.169 17 17 1892	
m.a. gap	0.36** (0.05)	-0.341** (0.149)	0.026 31 27 3448	0.83*** (0.04)	-0.728* (0.391)	7.402*** (1.994)	0.221 17 17 1892	
German 1y bill		0.46 (0.05)	-0.039 (0.086)	0.001 30 27 2688	0.80*** (0.05)	-0.194 (0.148)	8.234*** (1.930)	0.166 16 17 1520
3y growth	0.67*** (0.05)	0.011*** (0.003)	0.058 30 27 2364	0.82*** (0.03)	0.016*** (0.002)	8.525*** (1.937)	0.233 16 17 1352	
1y growth	0.73*** (0.05)	0.028*** (0.005)	0.096 30 27 2580	0.89*** (0.02)	0.042*** (0.003)	9.377*** (2.140)	0.327 16 17 1464	
3y difference	0.64** (0.06)	0.179** (0.077)	0.030 30 27 2364	0.80*** (0.04)	0.287*** (0.057)	8.360*** (1.815)	0.198 16 17 1352	
1y difference	0.71*** (0.05)	0.509*** (0.156)	0.059 30 27 2580	0.86*** (0.03)	0.874*** (0.108)	9.255*** (1.941)	0.274 16 17 1464	
trend gap	0.65** (0.06)	0.306** (0.131)	0.038 30 27 2175	0.80*** (0.04)	0.562*** (0.111)	8.576*** (1.867)	0.223 16 17 1254	
relative gap	0.71*** (0.05)	0.021*** (0.006)	0.088 30 27 2175	0.86*** (0.03)	0.037*** (0.005)	9.188*** (2.181)	0.319 16 17 1254	
5y m.a. gap	0.64** (0.06)	0.296** (0.132)	0.033 30 27 2175	0.81*** (0.04)	0.548*** (0.101)	8.365*** (1.859)	0.217 16 17 1254	
m.a. gap	0.60** (0.04)	0.116 (0.081)	0.008 30 27 2175	0.75*** (0.05)	0.039 (0.105)	8.207*** (1.768)	0.136 16 17 1254	
German 1m bill		0.42* (0.05)	-0.113 (0.073)	0.009 30 27 3104	0.83*** (0.04)	-0.295* (0.164)	8.299*** (1.945)	0.196 16 17 1728
3y growth	0.63*** (0.04)	3.3e-03** (1.3e-03)	0.009 30 27 2792	0.78*** (0.05)	5.5e-03*** (1.2e-03)	9.500*** (1.901)	0.174 16 17 1572	
1y growth	0.68*** (0.05)	0.012*** (0.003)	0.030 30 27 3000	0.84*** (0.04)	0.021*** (0.002)	10.573*** (2.157)	0.245 16 17 1676	
3y difference	0.62** (0.05)	0.074* (0.040)	0.008 30 27 2792	0.78*** (0.05)	0.129*** (0.032)	9.270*** (1.846)	0.171 16 17 1572	
1y difference	0.63** (0.05)	0.179** (0.075)	0.013 30 27 3000	0.81*** (0.05)	0.431*** (0.069)	10.353*** (2.047)	0.213 16 17 1676	
trend gap	0.71*** (0.05)	0.397*** (0.100)	0.072 30 27 2607	0.82*** (0.03)	0.533*** (0.088)	8.652*** (1.869)	0.235 16 17 1478	
relative gap	0.76*** (0.05)	0.025*** (0.005)	0.117 30 27 2607	0.87*** (0.02)	0.036*** (0.005)	9.028*** (2.142)	0.321 16 17 1478	
5y m.a. gap	0.68*** (0.05)	0.350*** (0.116)	0.049 30 27 2607	0.81*** (0.04)	0.513*** (0.096)	8.668*** (1.864)	0.222 16 17 1478	
m.a. gap	0.57* (0.04)	0.110 (0.085)	0.006 30 27 2607	0.78*** (0.05)	-0.037 (0.122)	8.831*** (1.826)	0.149 16 17 1478	
US 10y T-note		0.32*** (0.04)	-0.319*** (0.084)	0.058 31 27 3961	0.84*** (0.03)	-0.379** (0.182)	7.046*** (2.079)	0.215 17 17 1892
3y growth	0.65*** (0.03)	0.011*** (0.003)	0.013 31 27 3637	0.83*** (0.04)	0.032*** (0.004)	11.903*** (2.381)	0.242 17 17 1892	
1y growth	0.55*** (0.01)	0.011*** (0.003)	0.005 31 27 3853	0.80*** (0.05)	0.022*** (0.002)	10.072*** (1.845)	0.176 17 17 1892	
3y difference	0.62*** (0.03)	0.071* (0.039)	0.003 31 27 3637	0.80*** (0.05)	0.280*** (0.041)	10.802*** (2.083)	0.197 17 17 1892	
1y difference	0.52* (0.01)	0.093*** (0.030)	0.002 31 27 3853	0.79*** (0.05)	0.237*** (0.041)	10.007*** (1.833)	0.169 17 17 1892	
trend gap	0.60* (0.05)	0.135 (0.097)	0.006 31 27 3448	0.83*** (0.04)	0.554*** (0.145)	9.844*** (2.021)	0.227 17 17 1892	
relative gap	0.64** (0.06)	0.034*** (0.012)	0.048 31 27 3448	0.89*** (0.03)	0.089*** (0.021)	10.359*** (2.525)	0.370 17 17 1892	
5y m.a. gap	0.62*** (0.03)	0.104** (0.043)	0.003 31 27 3448	0.80*** (0.05)	0.391*** (0.057)	10.612*** (2.024)	0.190 17 17 1892	
m.a. gap	0.33*** (0.03)	-0.326*** (0.060)	0.060 31 27 3448	0.82*** (0.04)	-0.272** (0.129)	7.917*** (1.926)	0.187 17 17 1892	
US 1y T-bill		0.44 (0.04)	-0.048 (0.035)	0.003 30 27 2688	0.77*** (0.05)	0.017 (0.058)	9.202*** (2.075)	0.151 16 17 1520
3y growth	0.82*** (0.04)	0.012*** (0.002)	0.235 30 27 2364	0.98*** (0.01)	0.022*** (0.006)	11.643*** (2.938)	0.617 16 17 1352	
1y growth	0.69*** (0.02)	0.011*** (0.001)	0.033 30 27 2580	0.83*** (0.05)	0.013*** (0.002)	8.864*** (1.700)	0.198 16 17 1464	
3y difference	0.82*** (0.04)	0.528*** (0.125)	0.203 30 27 2364	0.97*** (0.01)	1.589*** (0.330)	13.523*** (3.821)	0.631 16 17 1352	
1y difference	0.67*** (0.02)	0.357*** (0.045)	0.051 30 27 2580	0.83*** (0.04)	0.542*** (0.045)	9.408*** (1.855)	0.233 16 17 1464	
trend gap	0.76*** (0.03)	0.723*** (0.149)	0.110 30 27 2175	0.92*** (0.02)	1.586*** (0.145)	10.842*** (2.720)	0.407 16 17 1254	
relative gap	0.78*** (0.04)	0.033*** (0.007)	0.197 30 27 2175	0.96*** (0.02)	0.071*** (0.018)	10.404*** (3.627)	0.596 16 17 1254	
5y m.a. gap	0.80*** (0.04)	0.771*** (0.161)	0.168 30 27 2175	0.95*** (0.01)	1.846*** (0.219)	10.842*** (3.241)	0.535 16 17 1254	
m.a. gap	0.71*** (0.03)	0.507*** (0.112)	0.073 30 27 2175	0.86*** (0.03)	0.876*** (0.120)	9.890*** (2.175)	0.295 16 17 1254	
US 1m T-bill		0.39*** (0.03)	-0.096*** (0.028)	0.015 30 27 3104	0.79*** (0.05)	-0.018 (0.048)	9.511*** (2.127)	0.163 16 17 1728
3y growth	0.81*** (0.04)	0.010*** (0.002)	0.241 30 27 2792	0.97*** (0.01)	0.018*** (0.004)	12.553*** (2.857)	0.626 16 17 1572	
1y growth	0.71*** (0.03)	0.013*** (0.002)	0.052 30 27 3000	0.87*** (0.04)	0.017*** (0.002)	9.793*** (1.943)	0.253 16 17 1676	
3y difference	0.78*** (0.04)	0.227*** (0.037)	0.094 30 27 2792	0.92*** (0.02)	0.426*** (0.038)	11.479*** (2.657)	0.372 16 17 1572	
1y difference	0.68*** (0.02)	0.158*** (0.019)	0.023 30 27 3000	0.83*** (0.05)	0.292*** (0.028)	10.446*** (2.040)	0.218 16 17 1676	
trend gap	0.80*** (0.04)	0.750*** (0.167)	0.175 30 27 2607	0.95*** (0.01)	2.058*** (0.521)	9.905*** (3.293)	0.523 16 17 1478	
relative gap	0.80*** (0.04)	0.025*** (0.005)	0.234 30 27 2607	0.97*** (0.02)	0.050*** (0.013)	9.974*** (3.465)	0.632 16 17 1478	
5y m.a. gap	0.83*** (0.04)	0.852*** (0.184)	0.227 30 27 2607	0.97*** (0.01)	2.526*** (0.565)	12.551*** (3.869)	0.641 16 17 1478	
m.a. gap	0.71*** (0.04)	0.482*** (0.128)	0.068 30 27 2607	0.87*** (0.03)	0.903*** (0.124)	10.895*** (2.467)	0.320 16 17 1478	

Robust standard errors adjusted for clustering are reported in the parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1%-level.

Panel F: Measures of the strength of bank balance sheets, Laeven & Valencia crisis dataset

Indicator	Transformation	univariate					bivariate												
		AUC	Indicator Logit coeff.	pR2	Cr	Co N	AUC	Indicator Logit coeff.	Credit-to-GDP gap Logit coeff.										
Leverage ratio		0.34***	(0.05)	-0.251***	(0.073)	0.055	16	25	716	0.64*	(0.08)	-0.182**	(0.079)	3.700**	(1.604)	0.071	14	17	553
	3y growth	0.46	(0.07)	-8.3e-03	(1.3e-02)	0.004	16	24	420	0.58	(0.07)	7.5e-03	(1.8e-02)	3.222	(1.968)	0.030	14	17	349
	1y growth	0.49	(0.04)	-5.3e-03	(1.4e-02)	0.001	16	25	616	0.60	(0.06)	0.018	(0.018)	3.739**	(1.780)	0.043	14	17	485
	3y difference	0.49	(0.07)	0.014	(0.160)	0.000	16	24	420	0.59	(0.08)	0.197	(0.211)	3.387*	(1.848)	0.037	14	17	349
	1y difference	0.50	(0.05)	-0.024	(0.183)	0.000	16	25	616	0.60	(0.07)	0.251	(0.244)	3.695**	(1.770)	0.043	14	17	485
Loans / deposits		0.60	(0.06)	6.8e-03**	(3.0e-03)	0.023	16	25	498	0.64*	(0.07)	4.1e-03	(3.4e-03)	3.770**	(1.621)	0.067	14	17	370
	3y growth	0.24**	(0.09)	-0.053**	(0.026)	0.166	15	22	203	0.78**	(0.12)	-0.075*	(0.039)	7.302	(4.538)	0.221	13	16	167
	1y growth	0.47	(0.06)	-0.027	(0.026)	0.007	16	25	398	0.65**	(0.07)	-0.053	(0.043)	4.847***	(1.789)	0.075	14	17	302
	3y difference	0.29**	(0.08)	-0.033	(0.023)	0.075	15	22	203	0.76**	(0.11)	-0.050	(0.037)	7.017	(4.594)	0.120	13	16	167
	1y difference	0.49	(0.06)	-5.0e-03	(2.2e-02)	0.000	16	25	398	0.65**	(0.06)	-0.015	(0.035)	4.622**	(1.864)	0.063	14	17	302
Total assets / GDP		0.67***	(0.05)	0.030*	(0.018)	0.008	16	21	754	0.70***	(0.06)	0.333**	(0.165)	3.696	(2.279)	0.102	14	17	647
	3y growth	0.58	(0.06)	0.014	(0.010)	0.010	16	20	506	0.61	(0.07)	1.1e-03	(1.5e-02)	3.657*	(2.183)	0.042	14	17	467
	1y growth	0.62**	(0.05)	0.044**	(0.020)	0.018	16	21	670	0.65**	(0.07)	0.019	(0.026)	4.129**	(1.849)	0.059	14	17	587
	3y difference	0.67**	(0.06)	0.527**	(0.247)	0.032	16	20	506	0.67**	(0.07)	0.694	(0.679)	2.142	(2.612)	0.058	14	17	467
	1y difference	0.67***	(0.05)	1.024*	(0.523)	0.032	16	21	670	0.68**	(0.07)	1.598	(1.211)	3.061	(2.283)	0.073	14	17	587
Non-core liabilities / GDP		0.66**	(0.07)	0.043*	(0.023)	0.010	15	20	389	0.69**	(0.08)	0.412	(0.361)	3.006*	(1.802)	0.079	13	16	338
	3y growth	0.35	(0.16)	-0.017	(0.014)	0.047	13	17	159	0.78**	(0.11)	-0.049***	(0.017)	7.558**	(3.271)	0.225	12	15	147
	1y growth	0.57	(0.06)	0.013	(0.019)	0.004	15	20	309	0.64**	(0.07)	-1.0e-02	(1.7e-02)	4.211***	(1.603)	0.060	13	16	274
	3y difference	0.81**	(0.12)	6.823	(4.485)	0.228	13	17	159	0.79	(0.14)	6.208	(4.543)	1.620	(4.295)	0.185	12	15	147
	1y difference	0.65**	(0.06)	1.965***	(0.750)	0.047	15	20	309	0.65**	(0.07)	0.639	(1.516)	3.607*	(1.975)	0.060	13	16	274
Non-core liabilities / Total assets		0.70***	(0.06)	4.753**	(1.893)	0.080	15	24	458	0.66*	(0.08)	3.438	(2.387)	3.147**	(1.473)	0.090	13	16	338
	3y growth	0.31	(0.12)	-0.055*	(0.030)	0.125	13	20	180	0.74	(0.13)	-0.065	(0.046)	4.169	(3.179)	0.155	12	15	147
	1y growth	0.46	(0.05)	-0.024	(0.021)	0.007	15	24	362	0.64**	(0.06)	-0.016	(0.028)	4.013**	(1.593)	0.060	13	16	274
	3y difference	0.36	(0.12)	-9.453	(8.448)	0.045	13	20	180	0.70	(0.13)	-10.169	(14.391)	4.172	(3.142)	0.077	12	15	147
	1y difference	0.48	(0.05)	-1.972	(6.057)	0.001	15	24	362	0.64**	(0.06)	0.465	(8.929)	4.034**	(1.628)	0.058	13	16	274
Foreign currency cross border loans / GDP		0.73***	(0.07)	0.452***	(0.122)	0.007	13	15	898	0.81***	(0.04)	18.691	(14.440)	3.987	(2.981)	0.136	11	11	818
	3y growth	0.56	(0.08)	-1.2e-03	(1.8e-03)	0.004	12	14	699	0.68**	(0.07)	-1.7e-03	(1.8e-03)	5.552***	(1.862)	0.087	10	11	663
	1y growth	0.59	(0.06)	-2.2e-04	(1.6e-03)	0.000	13	15	811	0.68**	(0.07)	-5.3e-05	(1.5e-03)	5.636***	(1.790)	0.082	11	11	747
	3y difference	0.79***	(0.06)	1.357	(1.310)	0.003	13	14	730	0.86***	(0.04)	124.861***	(28.688)	3.726	(2.433)	0.268	11	11	694
	1y difference	0.73***	(0.05)	4.116**	(1.860)	0.008	13	15	842	0.85***	(0.04)	142.378**	(60.934)	4.868**	(2.361)	0.195	11	11	778
	trend gap	0.80***	(0.06)	20.392	(74.852)	0.018	12	12	639	0.87***	(0.04)	201.174***	(68.337)	3.189	(2.102)	0.266	11	11	617
	relative gap	0.67*	(0.08)	4.9e-03	(3.8e-03)	0.014	12	12	627	0.69**	(0.08)	2.8e-03	(3.0e-03)	5.011***	(1.789)	0.084	11	11	605
	5y m.a. gap	0.83***	(0.06)	44.908	(103.928)	0.064	12	12	639	0.88***	(0.04)	207.098***	(71.694)	3.993*	(2.236)	0.297	11	11	617
	m.a. gap	0.83***	(0.06)	34.197	(57.015)	0.071	12	12	639	0.90***	(0.03)	135.659***	(42.514)	4.662**	(2.082)	0.340	11	11	617
	Own currency cross border loans / GDP		0.73***	(0.07)	0.746***	(0.179)	0.010	13	15	898	0.83***	(0.04)	23.759	(18.969)	3.670	(3.213)	0.139	11	11
3y growth		0.55	(0.07)	-1.7e-03	(2.0e-03)	0.006	12	14	699	0.68**	(0.08)	-2.8e-03	(2.1e-03)	5.760***	(1.870)	0.094	10	11	663
1y growth		0.58	(0.06)	-8.8e-04	(1.6e-03)	0.001	13	15	811	0.68***	(0.07)	-9.1e-04	(1.6e-03)	5.652***	(1.782)	0.083	11	11	747
3y difference		0.79***	(0.05)	5.817***	(2.193)	0.022	13	14	730	0.82***	(0.05)	66.859	(68.266)	4.222*	(2.388)	0.141	11	11	694
1y difference		0.70***	(0.06)	7.172***	(2.202)	0.015	13	15	842	0.78***	(0.06)	62.364	(80.890)	5.329**	(2.087)	0.115	11	11	778
trend gap		0.78***	(0.07)	142.886*	(80.027)	0.132	12	12	639	0.83***	(0.05)	163.547**	(71.841)	5.628*	(2.941)	0.200	11	11	617
relative gap		0.65	(0.08)	4.1e-03	(3.5e-03)	0.010	12	12	627	0.69**	(0.08)	2.1e-03	(3.1e-03)	5.087***	(1.779)	0.082	11	11	605
Foreign currency cross border loans / Assets		0.58	(0.07)	3.130	(8.741)	0.001	12	16	558	0.64	(0.08)	18.806	(32.114)	3.294	(2.219)	0.045	10	11	458
	3y growth	0.50	(0.06)	-3.6e-03	(2.4e-03)	0.010	12	15	370	0.54	(0.08)	-1.9e-03	(2.5e-03)	2.047	(2.069)	0.018	10	11	326
	1y growth	0.52	(0.05)	-3.1e-03	(4.0e-03)	0.002	12	16	494	0.56	(0.08)	2.0e-03	(6.0e-03)	2.992	(2.134)	0.029	10	11	414
	3y difference	0.57	(0.06)	24.946	(24.227)	0.005	12	15	370	0.69**	(0.07)	125.263**	(53.025)	3.198	(2.575)	0.068	10	11	326
	1y difference	0.60**	(0.05)	61.482	(39.669)	0.010	12	16	494	0.73***	(0.06)	265.247***	(101.944)	3.793	(2.420)	0.093	10	11	414
Own currency cross border loans / Assets		0.60	(0.07)	12.114	(12.588)	0.004	12	16	558	0.67**	(0.07)	40.500	(51.638)	3.061	(2.363)	0.054	10	11	458
	3y growth	0.45	(0.06)	-6.0e-03*	(3.1e-03)	0.021	12	15	370	0.56	(0.08)	-5.2e-03	(3.2e-03)	2.051	(1.991)	0.030	10	11	326
	1y growth	0.49	(0.05)	-5.2e-03	(3.2e-03)	0.006	12	16	494	0.57	(0.08)	-2.9e-03	(3.3e-03)	2.895	(2.050)	0.030	10	11	414
	3y difference	0.59	(0.06)	30.685	(35.140)	0.004	12	15	370	0.63*	(0.08)	57.211	(46.994)	2.438	(2.163)	0.026	10	11	326
	1y difference	0.58*	(0.05)	37.175	(37.628)	0.004	12	16	494	0.61	(0.08)	61.050	(62.317)	3.090	(2.080)	0.037	10	11	414
(ST liabilities - Liquid assets) / Total Assets		0.52	(0.07)	0.171	(1.583)	0.000	11	12	247	0.50	(0.10)	-0.751	(2.332)	2.295	(1.969)	0.018	10	11	227
	3y growth	0.47	(0.10)	-5.4e-04***	(1.8e-04)	0.007	11	12	103	0.50	(0.11)	-4.8e-04***	(1.3e-04)	0.557	(1.810)	0.008	10	11	95
	1y growth	0.65**	(0.07)	1.1e-03	(2.0e-03)	0.005	11	12	199	0.67***	(0.05)	0.022**	(0.011)	1.816	(1.530)	0.087	10	11	183
	3y difference	0.51	(0.10)	2.106	(5.689)	0.002	11	12	103	0.55	(0.11)	1.997	(5.966)	0.468	(1.827)	0.003	10	11	95
	1y difference	0.64**	(0.07)	16.833**	(7.321)	0.050	11	12	199	0.63*	(0.06)	12.979*	(7.269)	1.730	(1.492)	0.047	10	11	183
Short-term liabilities / Liquid assets		0.52	(0.07)	0.213	(0.401)	0.002	11	12	247	0.54	(0.07)	0.022	(0.628)	2.014	(2.201)	0.017	10	11	227
	3y growth	0.44	(0.13)	-0.013	(0.023)	0.006	11	12	103	0.57	(0.14)	-0.012	(0.024)	0.655	(1.803)	0.006	10	11	95
	1y growth	0.61*	(0.07)	0.042	(0.026)	0.022	11	12	199	0.58	(0.06)	0.026	(0.024)	1.723	(1.462)	0.026	10	11	183
	3y difference	0.38	(0.12)	-1.021	(1.255)	0.012	11	12	103	0.63	(0.13)	-0.915	(1.320)	0.777	(1.816)	0.011	10	11	95
	1y difference	0.59	(0.07)	1.575	(1.302)	0.011	11	12	199	0									

Annex C: Evaluation results for different horizons.

Table C1. AUCs for different horizons with Detken et al. (2014) crisis dataset. AUC values with $|AUC-0.5|>0.15$ are underlined and with $|AUC-0.5|>0.25$ double underlined. Also the 95 % confidence intervals and clustered bootstrapped standard errors are shown.

Panel A: Measures of credit developments

		Horizon	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Household credit (real) 3y growth Crises: 11 Countries: 14 Observations: 699	AUC	<u>0.70</u>	<u>0.71</u>	<u>0.70</u>	<u>0.70</u>	<u>0.69</u>	<u>0.70</u>	<u>0.70</u>	<u>0.71</u>	<u>0.70</u>	<u>0.72</u>	<u>0.71</u>	<u>0.71</u>	<u>0.71</u>	<u>0.71</u>	<u>0.73</u>	<u>0.71</u>	<u>0.72</u>	<u>0.70</u>	<u>0.68</u>	<u>0.63</u>	
	high	0.79	0.79	0.77	0.79	0.80	0.81	0.80	0.81	0.79	0.83	0.83	0.81	0.83	0.81	0.82	0.81	0.81	0.81	0.80	0.79	0.79
	low	0.58	0.60	0.61	0.59	0.56	0.58	0.56	0.60	0.56	0.58	0.57	0.58	0.59	0.59	0.62	0.61	0.62	0.59	0.57	0.52	
	S.E.	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.06	0.06	0.06
Household credit (real) relative gap Crises: 11 Countries: 14 Observations: 632	AUC	<u>0.70</u>	<u>0.71</u>	<u>0.70</u>	<u>0.71</u>	<u>0.71</u>	<u>0.71</u>	<u>0.71</u>	<u>0.73</u>	<u>0.72</u>	<u>0.74</u>	<u>0.73</u>	<u>0.75</u>	<u>0.73</u>	<u>0.73</u>	<u>0.72</u>	<u>0.71</u>	<u>0.71</u>	<u>0.69</u>	<u>0.66</u>	<u>0.64</u>	
	high	0.81	0.82	0.83	0.84	0.85	0.84	0.84	0.86	0.84	0.85	0.85	0.87	0.84	0.84	0.85	0.84	0.84	0.84	0.81	0.82	
	low	0.49	0.48	0.50	0.52	0.52	0.52	0.52	0.55	0.52	0.55	0.56	0.60	0.54	0.55	0.55	0.52	0.52	0.50	0.47	0.47	
	S.E.	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.09
Total credit / GDP trend gap Crises: 19 Countries: 18 Observations: 1491	AUC	<u>0.79</u>	<u>0.78</u>	<u>0.76</u>	<u>0.76</u>	<u>0.78</u>	<u>0.78</u>	<u>0.79</u>	<u>0.83</u>	<u>0.83</u>	<u>0.86</u>	<u>0.85</u>	<u>0.87</u>	<u>0.86</u>	<u>0.88</u>	<u>0.89</u>	<u>0.91</u>	<u>0.89</u>	<u>0.88</u>	<u>0.89</u>	<u>0.90</u>	
	high	0.85	0.86	0.85	0.84	0.86	0.86	0.87	0.88	0.89	0.90	0.90	0.91	0.90	0.91	0.93	0.94	0.94	0.94	0.95	0.95	
	low	0.70	0.68	0.66	0.68	0.69	0.69	0.71	0.77	0.76	0.80	0.79	0.82	0.79	0.82	0.84	0.85	0.83	0.80	0.82	0.82	
	S.E.	0.04	0.05	0.05	0.04	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.04	0.03	0.03
Total bank credit / GDP 3y diff. Crises: 20 Countries: 18 Observations: 1565	AUC	<u>0.78</u>	<u>0.79</u>	<u>0.77</u>	<u>0.78</u>	<u>0.79</u>	<u>0.79</u>	<u>0.79</u>	<u>0.82</u>	<u>0.83</u>	<u>0.85</u>	<u>0.86</u>	<u>0.87</u>	<u>0.88</u>	<u>0.87</u>	<u>0.88</u>	<u>0.88</u>	<u>0.88</u>	<u>0.87</u>	<u>0.87</u>	<u>0.87</u>	
	high	0.87	0.90	0.87	0.87	0.89	0.87	0.88	0.90	0.91	0.92	0.92	0.93	0.93	0.94	0.93	0.94	0.95	0.95	0.95	0.95	
	low	0.66	0.69	0.66	0.68	0.68	0.69	0.69	0.74	0.74	0.76	0.76	0.79	0.80	0.79	0.79	0.80	0.78	0.78	0.78	0.76	
	S.E.	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.05
Total bank credit / GDP trend gap Crises: 19 Countries: 18 Observations: 1459	AUC	<u>0.76</u>	<u>0.77</u>	<u>0.76</u>	<u>0.77</u>	<u>0.77</u>	<u>0.78</u>	<u>0.79</u>	<u>0.83</u>	<u>0.85</u>	<u>0.88</u>	<u>0.88</u>	<u>0.89</u>	<u>0.87</u>	<u>0.88</u>	<u>0.87</u>	<u>0.87</u>	<u>0.87</u>	<u>0.87</u>	<u>0.87</u>	<u>0.88</u>	
	high	0.86	0.87	0.85	0.85	0.87	0.87	0.88	0.90	0.90	0.92	0.92	0.93	0.93	0.93	0.92	0.94	0.94	0.94	0.95	0.95	
	low	0.65	0.66	0.65	0.68	0.69	0.69	0.72	0.76	0.78	0.82	0.82	0.83	0.82	0.80	0.79	0.79	0.78	0.78	0.79	0.79	
	S.E.	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
Total bank credit / GDP 1y diff. / 5y m.a. Crises: 20 Countries: 18 Observations: 1701	AUC	<u>0.72</u>	<u>0.73</u>	<u>0.73</u>	<u>0.76</u>	<u>0.80</u>	<u>0.82</u>	<u>0.84</u>	<u>0.86</u>	<u>0.86</u>	<u>0.86</u>	<u>0.87</u>	<u>0.87</u>	<u>0.88</u>	<u>0.86</u>	<u>0.85</u>	<u>0.83</u>	<u>0.84</u>	<u>0.83</u>	<u>0.82</u>	<u>0.79</u>	
	high	0.81	0.83	0.83	0.84	0.88	0.89	0.90	0.92	0.92	0.93	0.94	0.94	0.95	0.93	0.93	0.92	0.93	0.93	0.93	0.92	
	low	0.63	0.64	0.64	0.68	0.71	0.73	0.74	0.76	0.77	0.76	0.76	0.77	0.77	0.75	0.74	0.72	0.69	0.69	0.66	0.62	
	S.E.	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.07
Total household credit / GDP 3y diff. Crises: 17 Countries: 17 Observations: 974	AUC	<u>0.81</u>	<u>0.81</u>	<u>0.81</u>	<u>0.83</u>	<u>0.83</u>	<u>0.84</u>	<u>0.85</u>	<u>0.86</u>	<u>0.86</u>	<u>0.87</u>	<u>0.87</u>	<u>0.88</u>	<u>0.88</u>	<u>0.89</u>	<u>0.89</u>	<u>0.89</u>	<u>0.89</u>	<u>0.90</u>	<u>0.90</u>	<u>0.90</u>	<u>0.89</u>
	high	0.90	0.89	0.90	0.91	0.91	0.92	0.93	0.93	0.93	0.93	0.94	0.94	0.94	0.95	0.95	0.95	0.95	0.96	0.96	0.95	0.95
	low	0.70	0.71	0.72	0.73	0.72	0.74	0.75	0.76	0.76	0.77	0.77	0.78	0.78	0.80	0.80	0.82	0.82	0.82	0.82	0.80	
	S.E.	0.05	0.04	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.04
Total household credit / GDP 1y diff. Crises: 18 Countries: 18 Observations: 1089	AUC	<u>0.81</u>	<u>0.79</u>	<u>0.79</u>	<u>0.80</u>	<u>0.82</u>	<u>0.82</u>	<u>0.85</u>	<u>0.87</u>	<u>0.87</u>	<u>0.89</u>	<u>0.89</u>	<u>0.88</u>	<u>0.86</u>	<u>0.84</u>	<u>0.83</u>	<u>0.84</u>	<u>0.86</u>	<u>0.84</u>	<u>0.85</u>	<u>0.85</u>	
	high	0.88	0.88	0.88	0.89	0.91	0.91	0.91	0.92	0.91	0.94	0.93	0.94	0.93	0.90	0.90	0.89	0.92	0.92	0.92	0.92	
	low	0.73	0.71	0.67	0.67	0.69	0.71	0.74	0.79	0.78	0.83	0.84	0.81	0.76	0.77	0.75	0.76	0.77	0.75	0.75	0.74	
	S.E.	0.04	0.04	0.05	0.05	0.05	0.05	0.04	0.03	0.03	0.03	0.03	0.02	0.03	0.04	0.03	0.04	0.03	0.04	0.04	0.04	0.04
Total household credit / GDP trend gap Crises: 17 Countries: 17 Observations: 876	AUC	<u>0.76</u>	<u>0.76</u>	<u>0.77</u>	<u>0.78</u>	<u>0.80</u>	<u>0.81</u>	<u>0.82</u>	<u>0.84</u>	<u>0.85</u>	<u>0.86</u>	<u>0.86</u>	<u>0.87</u>	<u>0.88</u>	<u>0.88</u>	<u>0.88</u>	<u>0.86</u>	<u>0.86</u>	<u>0.85</u>	<u>0.83</u>	<u>0.83</u>	<u>0.84</u>
	high	0.87	0.86	0.87	0.87	0.89	0.90	0.91	0.92	0.92	0.92	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.92	0.93	0.92	
	low	0.63	0.64	0.62	0.68	0.69	0.69	0.71	0.75	0.76	0.78	0.79	0.79	0.79	0.79	0.77	0.77	0.76	0.71	0.72	0.71	
	S.E.	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05
Total household credit / GDP 1y diff. / 5y m.a. Crises: 18 Countries: 18 Observations: 1093	AUC	<u>0.81</u>	<u>0.81</u>	<u>0.81</u>	<u>0.83</u>	<u>0.84</u>	<u>0.85</u>	<u>0.86</u>	<u>0.87</u>	<u>0.88</u>	<u>0.89</u>	<u>0.90</u>	<u>0.89</u>	<u>0.89</u>	<u>0.88</u>	<u>0.87</u>	<u>0.85</u>	<u>0.85</u>	<u>0.83</u>	<u>0.82</u>	<u>0.79</u>	
	high	0.88	0.89	0.89	0.89	0.91	0.91	0.92	0.93	0.93	0.94	0.95	0.95	0.95	0.95	0.93	0.93	0.93	0.92	0.92	0.90	
	low	0.73	0.73	0.72	0.70	0.72	0.73	0.75	0.80	0.82	0.82	0.80	0.81	0.78	0.76	0.73	0.69	0.69	0.69	0.63		
	S.E.	0.04	0.04	0.04	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.05	0.06	0.06	0.07	0.07
Total corporate credit / GDP trend gap Crises: 17 Countries: 17 Observations: 857	AUC	<u>0.60</u>	<u>0.57</u>	<u>0.54</u>	<u>0.54</u>	<u>0.54</u>	<u>0.53</u>	<u>0.53</u>	<u>0.57</u>	<u>0.58</u>	<u>0.59</u>	<u>0.61</u>	<u>0.65</u>	<u>0.67</u>	<u>0.67</u>	<u>0.75</u>	<u>0.80</u>	<u>0.78</u>	<u>0.79</u>	<u>0.80</u>	<u>0.81</u>	
	high	0.70	0.69	0.67	0.67	0.67	0.65	0.65	0.68	0.68	0.71	0.71	0.76	0.77	0.77	0.84	0.89	0.90	0.90	0.90	0.91	
	low	0.44	0.41	0.37	0.39	0.39	0.39	0.39	0.41	0.43	0.46	0.47	0.51	0.54	0.54	0.61	0.65	0.63	0.62	0.66	0.66	
	S.E.	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.06	0.07	0.07	0.06	0.06

Panel B: Measures of private sector debt burden

		Horizon	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Household credit / Gross disposable income 3y diff. Crises: 14 Countries: 10 Observations: 742	AUC	<u>0.73</u>	<u>0.72</u>	<u>0.74</u>	<u>0.74</u>	<u>0.75</u>	<u>0.76</u>	<u>0.77</u>	<u>0.78</u>	<u>0.78</u>	<u>0.79</u>	<u>0.80</u>	<u>0.81</u>	<u>0.84</u>	<u>0.85</u>	<u>0.86</u>	<u>0.86</u>	<u>0.86</u>	<u>0.85</u>	<u>0.84</u>	<u>0.82</u>	
	high	0.85	0.84	0.86	0.86	0.86	0.87	0.88	0.91	0.90	0.91	0.91	0.92	0.93	0.94	0.95	0.95	0.95	0.95	0.96	0.94	0.91
	low	0.58																				

Debt-service-ratio (BIS) 1y diff.	AUC	0.46	0.44	0.42	0.37	0.38	0.43	0.49	0.57	0.59	0.63	0.66	0.68	0.73	0.74	0.80	0.83	0.82	0.80	0.75	0.72
Crises: 16	high	0.60	0.58	0.54	0.51	0.51	0.55	0.61	0.69	0.72	0.74	0.76	0.76	0.82	0.81	0.88	0.90	0.90	0.89	0.87	0.85
Countries: 12	low	0.33	0.30	0.31	0.27	0.27	0.34	0.38	0.44	0.46	0.50	0.57	0.58	0.65	0.66	0.72	0.75	0.73	0.74	0.65	0.56
Observations: 1035	S.E.	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.06	0.07
Debt-service-ratio (ESRB) 3y growth	AUC	0.66	0.63	0.60	0.58	0.64	0.65	0.67	0.66	0.69	0.71	0.72	0.73	0.74	0.76	0.79	0.81	0.82	0.81	0.82	0.82
Crises: 21	high	0.75	0.73	0.70	0.68	0.73	0.73	0.75	0.75	0.77	0.78	0.79	0.80	0.81	0.82	0.84	0.86	0.87	0.87	0.88	0.88
Countries: 23	low	0.55	0.50	0.46	0.45	0.54	0.55	0.59	0.57	0.59	0.63	0.64	0.64	0.66	0.68	0.72	0.73	0.74	0.74	0.73	0.73
Observations: 1637	S.E.	0.05	0.06	0.06	0.06	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.04	0.04	0.04
Debt-service-ratio (ESRB) 1y growth	AUC	0.61	0.61	0.61	0.59	0.60	0.62	0.66	0.69	0.68	0.73	0.74	0.77	0.79	0.77	0.78	0.80	0.79	0.76	0.74	0.72
Crises: 21	high	0.71	0.69	0.71	0.69	0.69	0.71	0.72	0.75	0.76	0.80	0.79	0.83	0.85	0.82	0.84	0.85	0.87	0.84	0.83	0.82
Countries: 24	low	0.51	0.51	0.52	0.50	0.52	0.53	0.57	0.61	0.56	0.61	0.66	0.70	0.74	0.71	0.72	0.73	0.72	0.66	0.60	0.60
Observations: 1803	S.E.	0.05	0.05	0.05	0.05	0.04	0.05	0.04	0.04	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.05	0.06	0.06
Debt-service-ratio (ESRB) 3y diff.	AUC	0.68	0.67	0.62	0.60	0.65	0.66	0.67	0.67	0.70	0.72	0.73	0.75	0.76	0.78	0.85	0.86	0.86	0.86	0.86	0.86
Crises: 21	high	0.77	0.77	0.74	0.71	0.74	0.74	0.77	0.77	0.79	0.81	0.82	0.83	0.85	0.86	0.90	0.91	0.91	0.91	0.92	0.92
Countries: 23	low	0.56	0.54	0.51	0.48	0.56	0.57	0.58	0.58	0.61	0.62	0.64	0.65	0.67	0.69	0.78	0.80	0.79	0.79	0.79	0.80
Observations: 1637	S.E.	0.05	0.06	0.06	0.06	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03
Debt-service-ratio (ESRB) 1y diff.	AUC	0.60	0.60	0.62	0.59	0.62	0.63	0.65	0.69	0.69	0.77	0.80	0.81	0.83	0.83	0.84	0.85	0.84	0.81	0.78	0.77
Crises: 21	high	0.71	0.71	0.70	0.69	0.71	0.73	0.73	0.76	0.80	0.85	0.86	0.87	0.88	0.89	0.90	0.90	0.91	0.89	0.88	0.88
Countries: 24	low	0.49	0.50	0.53	0.51	0.54	0.54	0.56	0.60	0.57	0.66	0.72	0.73	0.78	0.77	0.76	0.79	0.76	0.72	0.65	0.64
Observations: 1803	S.E.	0.06	0.06	0.05	0.05	0.04	0.05	0.04	0.04	0.06	0.05	0.04	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.06	0.06
Debt-service-ratio (ESRB) trend gap	AUC	0.71	0.73	0.68	0.66	0.69	0.68	0.68	0.68	0.70	0.73	0.73	0.74	0.77	0.79	0.81	0.86	0.87	0.87	0.86	0.87
Crises: 18	high	0.81	0.83	0.79	0.78	0.80	0.78	0.79	0.77	0.82	0.82	0.82	0.85	0.87	0.89	0.89	0.92	0.94	0.94	0.93	0.94
Countries: 21	low	0.60	0.60	0.57	0.52	0.58	0.56	0.56	0.56	0.58	0.63	0.62	0.62	0.65	0.67	0.70	0.77	0.78	0.77	0.78	0.75
Observations: 1511	S.E.	0.05	0.06	0.05	0.06	0.06	0.06	0.06	0.05	0.06	0.05	0.05	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.04
Corporate debt-service-ratio (ESRB) 1y growth	AUC	0.43	0.43	0.46	0.47	0.48	0.51	0.51	0.57	0.60	0.67	0.73	0.78	0.77	0.76	0.76	0.75	0.74	0.71	0.67	0.64
Crises: 12	high	0.57	0.60	0.61	0.61	0.63	0.65	0.68	0.71	0.74	0.78	0.85	0.88	0.88	0.88	0.87	0.83	0.82	0.86	0.81	0.81
Countries: 22	low	0.29	0.29	0.34	0.33	0.34	0.33	0.33	0.42	0.47	0.54	0.63	0.68	0.67	0.66	0.65	0.62	0.56	0.57	0.48	0.48
Observations: 754	S.E.	0.07	0.08	0.07	0.07	0.07	0.08	0.09	0.08	0.07	0.06	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.07	0.08	0.08
Household debt-service-ratio (ESRB) 3y diff.	AUC	0.62	0.59	0.61	0.63	0.66	0.67	0.68	0.70	0.69	0.71	0.71	0.73	0.75	0.78	0.78	0.78	0.78	0.78	0.78	0.74
Crises: 11	high	0.74	0.73	0.77	0.76	0.78	0.79	0.81	0.81	0.81	0.84	0.86	0.89	0.90	0.91	0.90	0.92	0.91	0.91	0.92	0.85
Countries: 19	low	0.45	0.41	0.46	0.47	0.52	0.48	0.51	0.52	0.50	0.49	0.51	0.51	0.58	0.58	0.60	0.57	0.61	0.63	0.58	0.58
Observations: 579	S.E.	0.07	0.08	0.08	0.07	0.07	0.07	0.08	0.07	0.08	0.08	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.07
Household debt-service-ratio (ESRB) 1y diff.	AUC	0.69	0.64	0.62	0.63	0.63	0.63	0.65	0.72	0.70	0.75	0.77	0.80	0.83	0.80	0.77	0.70	0.69	0.63	0.61	0.57
Crises: 13	high	0.81	0.79	0.78	0.79	0.77	0.77	0.78	0.82	0.82	0.86	0.89	0.92	0.92	0.91	0.88	0.85	0.82	0.76	0.79	0.76
Countries: 22	low	0.51	0.48	0.44	0.43	0.42	0.47	0.50	0.60	0.59	0.63	0.64	0.65	0.70	0.68	0.64	0.53	0.54	0.48	0.43	0.35
Observations: 724	S.E.	0.07	0.08	0.09	0.09	0.09	0.07	0.07	0.05	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.08	0.07	0.09	0.10
Household credit * 10y interest rate / GDP 3y diff.	AUC	0.58	0.59	0.58	0.59	0.51	0.57	0.52	0.49	0.52	0.57	0.62	0.73	0.73	0.69	0.73	0.78	0.82	0.81	0.86	0.92
Crises: 10	high	0.72	0.70	0.69	0.69	0.64	0.74	0.74	0.70	0.75	0.78	0.78	0.84	0.87	0.82	0.84	0.89	0.92	0.93	0.96	0.97
Countries: 15	low	0.42	0.48	0.48	0.48	0.40	0.39	0.33	0.27	0.32	0.36	0.47	0.59	0.59	0.53	0.57	0.58	0.60	0.60	0.65	0.82
Observations: 598	S.E.	0.07	0.06	0.05	0.05	0.06	0.09	0.10	0.11	0.11	0.08	0.07	0.09	0.08	0.07	0.08	0.08	0.08	0.08	0.07	0.03
Household credit * 10y interest rate / GDP 1y diff.	AUC	0.54	0.61	0.62	0.62	0.59	0.50	0.50	0.41	0.44	0.51	0.63	0.78	0.77	0.75	0.73	0.69	0.70	0.71	0.75	0.69
Crises: 13	high	0.67	0.74	0.72	0.74	0.72	0.63	0.65	0.58	0.61	0.65	0.75	0.90	0.92	0.92	0.90	0.84	0.85	0.82	0.87	0.86
Countries: 18	low	0.41	0.48	0.51	0.51	0.43	0.39	0.36	0.26	0.23	0.34	0.48	0.66	0.57	0.54	0.54	0.55	0.55	0.58	0.65	0.51
Observations: 678	S.E.	0.07	0.06	0.05	0.06	0.08	0.06	0.07	0.08	0.10	0.08	0.07	0.06	0.09	0.09	0.09	0.07	0.07	0.06	0.05	0.09
Household credit * 3m interest rate / GDP	AUC	0.51	0.50	0.50	0.50	0.51	0.52	0.52	0.53	0.56	0.59	0.63	0.66	0.71	0.75	0.77	0.78	0.78	0.78	0.78	0.77
Crises: 19	high	0.63	0.63	0.62	0.65	0.64	0.63	0.64	0.65	0.66	0.69	0.71	0.74	0.77	0.81	0.84	0.85	0.87	0.87	0.85	0.85
Countries: 25	low	0.39	0.37	0.39	0.38	0.39	0.38	0.41	0.40	0.41	0.44	0.47	0.53	0.55	0.60	0.65	0.66	0.67	0.67	0.67	0.66
Observations: 1026	S.E.	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.05
Household credit * 3m interest rate / GDP 3y growth	AUC	0.38	0.35	0.35	0.37	0.39	0.45	0.48	0.48	0.52	0.56	0.64	0.70	0.73	0.76	0.79	0.80	0.80	0.80	0.79	0.76
Crises: 13	high	0.54	0.50	0.51	0.53	0.54	0.57	0.59	0.61	0.63	0.68	0.75	0.80	0.82	0.85	0.87	0.88	0.88	0.88	0.88	0.85
Countries: 21	low	0.25	0.23	0.23	0.24	0.27	0.32	0.35	0.36	0.37	0.42	0.51	0.58	0.60	0.63	0.67	0.68	0.68	0.66	0.66	0.64
Observations: 793	S.E.	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.07	0.07	0.06	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.05
Household credit * 3m interest rate / GDP 1y growth	AUC	0.44	0.47	0.53	0.54	0.61	0.59	0.59	0.60	0.60	0.63	0.69	0.77	0.79	0.83	0.83	0.80	0.77	0.71	0.60	0.56
Crises: 18	high	0.58	0.61	0.65	0.67	0.72	0.68	0.69													

Panel C: Measures of potential overvaluation of property prices

Horizon		-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Residential property price / income	AUC	0.61	0.62	0.63	0.64	0.66	0.69	0.71	0.72	0.74	0.76	0.77	0.79	0.80	0.80	0.81	0.81	0.81	0.80	0.80	0.80
Crises: 19	high	0.74	0.74	0.75	0.76	0.78	0.80	0.81	0.83	0.85	0.86	0.87	0.88	0.89	0.89	0.91	0.90	0.90	0.89	0.89	0.89
Countries: 20	low	0.49	0.49	0.49	0.51	0.53	0.56	0.56	0.59	0.61	0.64	0.65	0.67	0.68	0.66	0.69	0.68	0.69	0.67	0.69	0.67
Observations: 1182	S.E.	0.06	0.06	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.06	0.06	0.05	0.05	0.06	0.05	0.05
Residential property price / income 3y growth	AUC	0.68	0.68	0.68	0.70	0.70	0.72	0.72	0.74	0.75	0.78	0.79	0.79	0.80	0.78	0.77	0.75	0.74	0.69	0.66	0.61
Crises: 18	high	0.79	0.78	0.78	0.80	0.78	0.82	0.81	0.82	0.83	0.87	0.88	0.88	0.88	0.87	0.86	0.84	0.85	0.80	0.77	0.72
Countries: 18	low	0.54	0.54	0.53	0.58	0.58	0.60	0.61	0.62	0.64	0.66	0.67	0.68	0.69	0.69	0.67	0.64	0.64	0.56	0.55	0.49
Observations: 981	S.E.	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06
Residential property price / income 1y growth	AUC	0.57	0.52	0.53	0.59	0.63	0.72	0.74	0.75	0.77	0.76	0.76	0.75	0.74	0.67	0.62	0.59	0.48	0.41	0.36	0.32
Crises: 19	high	0.70	0.67	0.67	0.71	0.74	0.81	0.85	0.84	0.85	0.85	0.84	0.85	0.83	0.76	0.73	0.70	0.60	0.54	0.48	0.42
Countries: 20	low	0.43	0.35	0.35	0.44	0.49	0.61	0.62	0.65	0.66	0.67	0.68	0.65	0.63	0.54	0.48	0.44	0.35	0.27	0.24	0.22
Observations: 1114	S.E.	0.07	0.08	0.08	0.07	0.06	0.05	0.06	0.05	0.05	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.06	0.07	0.06	0.05
Residential property price / income 3y diff.	AUC	0.69	0.69	0.69	0.71	0.70	0.73	0.75	0.76	0.76	0.79	0.80	0.81	0.81	0.80	0.80	0.77	0.77	0.72	0.69	0.63
Crises: 18	high	0.80	0.79	0.80	0.81	0.80	0.82	0.84	0.85	0.85	0.88	0.90	0.90	0.90	0.89	0.88	0.87	0.87	0.84	0.80	0.77
Countries: 18	low	0.55	0.54	0.56	0.57	0.57	0.61	0.64	0.65	0.66	0.65	0.69	0.70	0.70	0.69	0.68	0.65	0.65	0.57	0.55	0.47
Observations: 981	S.E.	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.06	0.08
Residential property price / income 1y diff.	AUC	0.58	0.52	0.52	0.60	0.64	0.74	0.75	0.76	0.78	0.77	0.78	0.77	0.75	0.68	0.63	0.61	0.48	0.41	0.35	0.31
Crises: 19	high	0.72	0.67	0.68	0.72	0.75	0.83	0.85	0.86	0.86	0.86	0.86	0.86	0.85	0.79	0.75	0.75	0.62	0.56	0.51	0.42
Countries: 20	low	0.42	0.33	0.36	0.44	0.48	0.59	0.60	0.64	0.67	0.69	0.69	0.66	0.63	0.55	0.49	0.43	0.34	0.25	0.22	0.20
Observations: 1114	S.E.	0.08	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.04	0.04	0.05	0.05	0.06	0.07	0.08	0.07	0.08	0.07	0.06
Residential property price / income trend gap	AUC	0.65	0.64	0.65	0.68	0.68	0.71	0.74	0.75	0.77	0.83	0.83	0.83	0.83	0.82	0.80	0.77	0.72	0.66	0.60	0.52
Crises: 18	high	0.77	0.77	0.79	0.81	0.81	0.82	0.84	0.85	0.87	0.90	0.91	0.91	0.92	0.92	0.89	0.88	0.84	0.79	0.74	0.67
Countries: 18	low	0.49	0.47	0.48	0.52	0.51	0.55	0.57	0.58	0.63	0.69	0.69	0.70	0.72	0.69	0.68	0.62	0.58	0.51	0.44	0.34
Observations: 876	S.E.	0.07	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.06	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.07	0.07	0.08	0.09

Panel D: Measures of external imbalances

Horizon		-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Current account / GDP	AUC	0.41	0.45	0.48	0.43	0.39	0.39	0.43	0.39	0.35	0.39	0.39	0.38	0.33	0.34	0.30	0.35	0.30	0.31	0.32	0.36
Crises: 21	high	0.53	0.58	0.60	0.58	0.50	0.50	0.54	0.54	0.51	0.52	0.51	0.54	0.47	0.47	0.43	0.50	0.43	0.44	0.45	0.51
Countries: 26	low	0.28	0.34	0.36	0.30	0.28	0.27	0.34	0.28	0.23	0.27	0.29	0.24	0.20	0.22	0.20	0.19	0.21	0.19	0.20	0.21
Observations: 1545	S.E.	0.07	0.06	0.06	0.07	0.06	0.06	0.05	0.06	0.07	0.07	0.06	0.08	0.07	0.06	0.06	0.08	0.06	0.06	0.06	0.07
Current account / GDP 3y growth	AUC	0.55	0.52	0.48	0.72	0.48	0.56	0.53	0.63	0.52	0.50	0.63	0.54	0.60	0.45	0.57	0.63	0.64	0.65	0.71	0.61
Crises: 18	high	0.63	0.61	0.62	0.62	0.61	0.69	0.65	0.78	0.63	0.65	0.74	0.71	0.69	0.58	0.74	0.75	0.77	0.78	0.82	0.72
Countries: 25	low	0.46	0.39	0.36	0.32	0.37	0.42	0.42	0.49	0.36	0.36	0.50	0.38	0.49	0.32	0.41	0.49	0.51	0.50	0.58	0.49
Observations: 1285	S.E.	0.05	0.06	0.07	0.05	0.06	0.07	0.06	0.07	0.07	0.07	0.06	0.08	0.05	0.07	0.08	0.07	0.07	0.07	0.06	0.06
Current account / GDP 1y growth	AUC	0.54	0.56	0.43	0.64	0.45	0.42	0.56	0.54	0.68	0.61	0.48	0.61	0.63	0.65	0.61	0.57	0.58	0.60	0.49	0.56
Crises: 21	high	0.65	0.69	0.56	0.78	0.53	0.54	0.69	0.66	0.77	0.72	0.61	0.70	0.70	0.75	0.74	0.65	0.67	0.71	0.61	0.66
Countries: 26	low	0.42	0.43	0.33	0.53	0.37	0.34	0.43	0.42	0.56	0.47	0.36	0.49	0.54	0.54	0.47	0.47	0.49	0.49	0.37	0.47
Observations: 1457	S.E.	0.06	0.07	0.06	0.06	0.04	0.05	0.07	0.06	0.05	0.06	0.06	0.06	0.04	0.05	0.07	0.05	0.05	0.06	0.06	0.05
Current account / GDP 3y diff.	AUC	0.61	0.58	0.50	0.47	0.46	0.42	0.36	0.39	0.37	0.44	0.39	0.35	0.34	0.34	0.28	0.30	0.33	0.34	0.33	0.40
Crises: 18	high	0.70	0.67	0.62	0.58	0.58	0.50	0.43	0.49	0.48	0.59	0.51	0.47	0.43	0.44	0.39	0.40	0.46	0.46	0.43	0.54
Countries: 25	low	0.51	0.44	0.36	0.34	0.34	0.32	0.28	0.29	0.26	0.29	0.26	0.24	0.23	0.23	0.17	0.21	0.24	0.25	0.24	0.30
Observations: 1286	S.E.	0.05	0.06	0.07	0.06	0.06	0.04	0.03	0.05	0.06	0.07	0.06	0.06	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.06
Current account / GDP 1y diff.	AUC	0.44	0.49	0.52	0.41	0.43	0.40	0.43	0.43	0.39	0.44	0.40	0.39	0.37	0.36	0.30	0.36	0.42	0.40	0.49	0.49
Crises: 21	high	0.54	0.62	0.62	0.51	0.53	0.50	0.53	0.54	0.49	0.57	0.50	0.50	0.45	0.47	0.41	0.43	0.54	0.54	0.62	0.64
Countries: 26	low	0.35	0.37	0.40	0.30	0.34	0.31	0.33	0.35	0.29	0.33	0.29	0.30	0.28	0.25	0.21	0.29	0.32	0.29	0.39	0.36
Observations: 1458	S.E.	0.05	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.04	0.05	0.05	0.03	0.06	0.07	0.06	0.07
Portfolio investments / GDP 1y diff.	AUC	0.52	0.49	0.44	0.41	0.47	0.50	0.46	0.39	0.45	0.57	0.49	0.50	0.54	0.49	0.47	0.49	0.33	0.33	0.37	0.33
Crises: 5	high	0.71	0.64	0.64	0.59	0.64	0.75	0.65	0.55	0.69	0.81	0.80	0.71	0.77	0.73	0.79	0.75	0.54	0.60	0.60	0.62
Countries: 19	low	0.36	0.35	0.29	0.25	0.29	0.31	0.21	0.22	0.28	0.40	0.30	0.34	0.32	0.28	0.25	0.28	0.18	0.11	0.16	0.11
Observations: 402	S.E.	0.09	0.07	0.09	0.08	0.09	0.11	0.11	0.08	0.10	0.10	0.12	0.10	0.12	0.11	0.13	0.12	0.08	0.12	0.11	0.12
Other investments / GDP 1y diff.	AUC	0.52	0.49	0.44	0.41	0.47	0.50	0.46	0.39	0.45	0.57	0.49	0.50	0.54	0.49	0.47	0.49	0.33	0.33	0.37	0.33
Crises: 5	high	0.69	0.66	0.68	0.60	0.65	0.74	0.66	0.53	0.66	0.79	0.81	0.71	0.76	0.73	0.74	0.72	0.52	0.64	0.67	0.62
Countries: 19	low	0.36	0.36	0.29	0.26	0.32	0.31	0.23	0.21	0.30	0.40	0.30	0.31	0.32	0.29	0.22	0.25	0.19	0.12	0.16	0.10
Observations: 402	S.E.	0.09	0.07	0.09	0.09	0.08	0.11	0.11	0.08	0.09	0.10	0.12	0.10	0.11	0.11	0.13	0.12	0.08	0.12	0.12	0.13

Panel E: Measures of potential mispricing of risk

	Horizon	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Stock market index 3y growth	AUC	<u>0.21</u>	<u>0.23</u>	<u>0.27</u>	<u>0.31</u>	<u>0.30</u>	<u>0.39</u>	<u>0.41</u>	<u>0.42</u>	<u>0.58</u>	<u>0.60</u>	<u>0.68</u>	<u>0.71</u>	<u>0.71</u>	<u>0.72</u>	<u>0.70</u>	<u>0.68</u>	<u>0.70</u>	<u>0.62</u>	<u>0.48</u>	<u>0.48</u>
Crises: 11	high	0.34	0.36	0.39	0.43	0.43	0.54	0.53	0.55	0.67	0.68	0.80	0.83	0.80	0.83	0.82	0.80	0.80	0.76	0.68	0.66
Countries: 14	low	0.10	0.12	0.14	0.18	0.19	0.27	0.29	0.31	0.50	0.51	0.54	0.58	0.60	0.59	0.61	0.61	0.62	0.53	0.36	0.35
Observations: 782	S.E.	0.06	0.06	0.06	0.07	0.06	0.07	0.06	0.06	0.04	0.04	0.07	0.07	0.05	0.06	0.06	0.05	0.05	0.06	0.08	0.08
Bank stock index 3y growth	AUC	<u>0.34</u>	<u>0.34</u>	<u>0.37</u>	<u>0.40</u>	<u>0.42</u>	<u>0.47</u>	<u>0.46</u>	<u>0.50</u>	<u>0.59</u>	<u>0.62</u>	<u>0.67</u>	<u>0.59</u>	<u>0.60</u>	<u>0.61</u>	<u>0.63</u>	<u>0.58</u>	<u>0.53</u>	<u>0.43</u>	<u>0.35</u>	<u>0.30</u>
Crises: 14	high	0.40	0.39	0.42	0.47	0.49	0.57	0.56	0.60	0.68	0.72	0.82	0.71	0.72	0.73	0.71	0.69	0.67	0.55	0.49	0.44
Countries: 13	low	0.28	0.27	0.30	0.31	0.34	0.39	0.36	0.38	0.50	0.46	0.51	0.45	0.47	0.49	0.50	0.46	0.42	0.32	0.23	0.18
Observations: 763	S.E.	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.08	0.07	0.06	0.06	0.05	0.06	0.06	0.06	0.07	0.07
High-yield spread	AUC	<u>0.34</u>	<u>0.28</u>	<u>0.25</u>	<u>0.23</u>	<u>0.20</u>	<u>0.17</u>	<u>0.22</u>	<u>0.23</u>	<u>0.23</u>	<u>0.22</u>	<u>0.15</u>	<u>0.18</u>	<u>0.11</u>	<u>0.10</u>	<u>0.06</u>	<u>0.10</u>	<u>0.17</u>	<u>0.28</u>	<u>0.38</u>	<u>0.46</u>
Crises: 14	high	0.48	0.38	0.35	0.35	0.34	0.31	0.36	0.42	0.40	0.34	0.29	0.33	0.24	0.21	0.15	0.20	0.26	0.40	0.54	0.61
Countries: 28	low	0.26	0.21	0.17	0.17	0.12	0.09	0.15	0.15	0.15	0.08	0.10	0.05	0.04	0.02	0.04	0.11	0.19	0.26	0.35	
Observations: 821	S.E.	0.05	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.06	0.04	0.04	0.03	0.04	0.04	0.06	0.07	0.07
High-yield spread 3y growth	AUC	<u>0.31</u>	<u>0.23</u>	<u>0.17</u>	<u>0.11</u>	<u>0.06</u>	<u>0.06</u>	<u>0.11</u>	<u>0.13</u>	<u>0.12</u>	<u>0.22</u>	<u>0.22</u>	<u>0.34</u>	<u>0.32</u>	<u>0.32</u>	<u>0.35</u>	<u>0.41</u>	<u>0.49</u>	<u>0.60</u>	<u>0.71</u>	<u>0.72</u>
Crises: 13	high	0.41	0.35	0.26	0.22	0.13	0.10	0.15	0.18	0.20	0.28	0.29	0.39	0.38	0.38	0.42	0.50	0.57	0.71	0.80	0.82
Countries: 28	low	0.22	0.14	0.12	0.07	0.02	0.04	0.07	0.09	0.07	0.17	0.16	0.29	0.25	0.28	0.29	0.34	0.42	0.49	0.59	0.63
Observations: 544	S.E.	0.05	0.05	0.04	0.03	0.02	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.06	0.05	0.05
High-yield spread 1y growth	AUC	<u>0.11</u>	<u>0.12</u>	<u>0.15</u>	<u>0.29</u>	<u>0.32</u>	<u>0.33</u>	<u>0.51</u>	<u>0.53</u>	<u>0.56</u>	<u>0.58</u>	<u>0.41</u>	<u>0.41</u>	<u>0.35</u>	<u>0.25</u>	<u>0.30</u>	<u>0.34</u>	<u>0.59</u>	<u>0.68</u>	<u>0.81</u>	<u>0.82</u>
Crises: 14	high	0.18	0.20	0.26	0.40	0.45	0.46	0.59	0.61	0.62	0.67	0.46	0.51	0.41	0.37	0.44	0.52	0.73	0.84	0.93	0.92
Countries: 28	low	0.06	0.06	0.09	0.20	0.21	0.23	0.42	0.42	0.49	0.49	0.35	0.34	0.27	0.16	0.22	0.20	0.44	0.48	0.64	0.66
Observations: 732	S.E.	0.03	0.04	0.04	0.05	0.06	0.06	0.04	0.05	0.03	0.05	0.03	0.04	0.04	0.05	0.05	0.08	0.08	0.09	0.07	0.06
High-yield spread 3y diff.	AUC	<u>0.32</u>	<u>0.21</u>	<u>0.16</u>	<u>0.09</u>	<u>0.06</u>	<u>0.07</u>	<u>0.12</u>	<u>0.13</u>	<u>0.12</u>	<u>0.21</u>	<u>0.23</u>	<u>0.33</u>	<u>0.34</u>	<u>0.37</u>	<u>0.41</u>	<u>0.44</u>	<u>0.47</u>	<u>0.54</u>	<u>0.59</u>	<u>0.66</u>
Crises: 13	high	0.45	0.35	0.26	0.15	0.12	0.10	0.16	0.18	0.18	0.28	0.31	0.38	0.40	0.42	0.46	0.51	0.52	0.64	0.70	0.77
Countries: 28	low	0.22	0.13	0.11	0.05	0.02	0.05	0.09	0.09	0.07	0.17	0.18	0.27	0.27	0.32	0.35	0.39	0.41	0.47	0.53	0.55
Observations: 544	S.E.	0.06	0.05	0.04	0.02	0.02	0.01	0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.04	0.04	0.04	0.06
CBOE Volatility Index	AUC	<u>0.54</u>	<u>0.47</u>	<u>0.40</u>	<u>0.36</u>	<u>0.34</u>	<u>0.32</u>	<u>0.30</u>	<u>0.28</u>	<u>0.26</u>	<u>0.23</u>	<u>0.21</u>	<u>0.23</u>	<u>0.22</u>	<u>0.23</u>	<u>0.24</u>	<u>0.26</u>	<u>0.32</u>	<u>0.35</u>	<u>0.43</u>	<u>0.46</u>
Crises: 27	high	0.67	0.57	0.49	0.47	0.44	0.42	0.40	0.37	0.37	0.32	0.29	0.30	0.30	0.31	0.32	0.33	0.40	0.44	0.54	0.56
Countries: 28	low	0.43	0.38	0.30	0.27	0.25	0.23	0.22	0.19	0.18	0.16	0.15	0.16	0.16	0.17	0.17	0.19	0.25	0.27	0.34	0.37
Observations: 1768	S.E.	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05
CBOE Volatility Index 3y growth	AUC	<u>0.47</u>	<u>0.40</u>	<u>0.33</u>	<u>0.26</u>	<u>0.22</u>	<u>0.20</u>	<u>0.20</u>	<u>0.21</u>	<u>0.21</u>	<u>0.21</u>	<u>0.23</u>	<u>0.25</u>	<u>0.29</u>	<u>0.35</u>	<u>0.40</u>	<u>0.48</u>	<u>0.57</u>	<u>0.65</u>	<u>0.69</u>	
Crises: 23	high	0.55	0.49	0.41	0.35	0.31	0.29	0.29	0.31	0.32	0.32	0.32	0.33	0.37	0.41	0.49	0.54	0.60	0.69	0.78	0.80
Countries: 28	low	0.39	0.31	0.24	0.19	0.14	0.13	0.11	0.11	0.11	0.11	0.11	0.14	0.15	0.18	0.24	0.28	0.35	0.43	0.51	0.54
Observations: 1495	S.E.	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.07	
CBOE Volatility Index 3y diff.	AUC	<u>0.48</u>	<u>0.40</u>	<u>0.32</u>	<u>0.26</u>	<u>0.21</u>	<u>0.19</u>	<u>0.19</u>	<u>0.20</u>	<u>0.21</u>	<u>0.21</u>	<u>0.21</u>	<u>0.23</u>	<u>0.26</u>	<u>0.31</u>	<u>0.36</u>	<u>0.41</u>	<u>0.49</u>	<u>0.55</u>	<u>0.65</u>	<u>0.68</u>
Crises: 23	high	0.57	0.50	0.41	0.36	0.30	0.29	0.30	0.31	0.32	0.32	0.32	0.36	0.38	0.44	0.47	0.53	0.62	0.67	0.76	0.79
Countries: 28	low	0.40	0.32	0.24	0.18	0.14	0.12	0.11	0.11	0.11	0.12	0.14	0.15	0.21	0.25	0.30	0.37	0.41	0.49	0.54	
Observations: 1495	S.E.	0.04	0.05	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.07	0.06	0.06
CBOE Volatility Index trend gap	AUC	<u>0.39</u>	<u>0.33</u>	<u>0.28</u>	<u>0.24</u>	<u>0.22</u>	<u>0.21</u>	<u>0.20</u>	<u>0.20</u>	<u>0.21</u>	<u>0.22</u>	<u>0.23</u>	<u>0.25</u>	<u>0.27</u>	<u>0.30</u>	<u>0.32</u>	<u>0.35</u>	<u>0.38</u>	<u>0.44</u>	<u>0.52</u>	<u>0.56</u>
Crises: 21	high	0.47	0.44	0.38	0.35	0.33	0.32	0.30	0.32	0.33	0.33	0.35	0.39	0.40	0.44	0.45	0.48	0.51	0.59	0.65	0.68
Countries: 28	low	0.29	0.24	0.19	0.15	0.13	0.11	0.10	0.09	0.10	0.11	0.12	0.14	0.16	0.17	0.19	0.21	0.24	0.31	0.38	0.43
Observations: 1357	S.E.	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	
German 1y bill 3y growth	AUC	<u>0.33</u>	<u>0.31</u>	<u>0.32</u>	<u>0.32</u>	<u>0.33</u>	<u>0.38</u>	<u>0.34</u>	<u>0.35</u>	<u>0.42</u>	<u>0.49</u>	<u>0.53</u>	<u>0.59</u>	<u>0.61</u>	<u>0.63</u>	<u>0.66</u>	<u>0.66</u>	<u>0.67</u>	<u>0.67</u>	<u>0.68</u>	<u>0.69</u>
Crises: 29	high	0.46	0.43	0.44	0.44	0.44	0.48	0.45	0.46	0.53	0.60	0.65	0.71	0.72	0.74	0.77	0.78	0.79	0.80	0.79	0.81
Countries: 28	low	0.23	0.21	0.23	0.22	0.23	0.27	0.25	0.27	0.33	0.39	0.41	0.47	0.46	0.51	0.53	0.50	0.52	0.52	0.55	0.55
Observations: 1945	S.E.	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.06	0.07
German 1y bill 1y growth	AUC	<u>0.37</u>	<u>0.39</u>	<u>0.41</u>	<u>0.50</u>	<u>0.51</u>	<u>0.53</u>	<u>0.56</u>	<u>0.51</u>	<u>0.57</u>	<u>0.60</u>	<u>0.62</u>	<u>0.67</u>	<u>0.69</u>	<u>0.69</u>	<u>0.69</u>	<u>0.67</u>	<u>0.67</u>	<u>0.63</u>	<u>0.63</u>	<u>0.65</u>
Crises: 29	high	0.49	0.51	0.53	0.62	0.63	0.61	0.65	0.58	0.65	0.68	0.71	0.76	0.80	0.81	0.81	0.79	0.77	0.72	0.71	0.73
Countries: 28	low	0.27	0.30	0.30	0.38	0.40	0.44	0.46	0.44	0.48	0.52	0.53	0.54	0.56	0.54	0.53	0.53	0.55	0.51	0.54	0.55
Observations: 2153	S.E.	0.05	0.05	0.06	0.06	0.06	0.04	0.04	0.04	0.04	0.04	0.05	0.06	0.06	0.07	0.07	0.07	0.06	0.05	0.05	0.05
German 1y bill 1y diff.	AUC	<u>0.41</u>	<u>0.42</u>	<u>0.44</u>	<u>0.48</u>	<u>0.50</u>	<u>0.52</u>	<u>0.55</u>	<u>0.52</u>	<u>0.57</u>	<u>0.58</u>	<u>0.59</u>	<u>0.64</u>	<u>0.67</u>	<u>0.67</u>	<u>0.68</u>	<u>0.66</u>	<u>0.66</u>	<u>0.63</u>	<u>0.62</u> </	

US 1y T-bill 3y growth	AUC	0.30	0.28	0.34	0.39	0.47	0.57	0.61	0.68	0.71	0.74	0.75	0.75	0.75	0.74	0.71	0.70	0.63	0.54	0.55		
Crises: 29	high	0.41	0.38	0.42	0.49	0.58	0.68	0.72	0.78	0.80	0.82	0.85	0.86	0.85	0.86	0.84	0.80	0.79	0.72	0.62	0.63	
Countries: 28	low	0.20	0.20	0.23	0.30	0.35	0.45	0.48	0.56	0.59	0.61	0.63	0.64	0.60	0.62	0.60	0.57	0.60	0.55	0.46	0.47	
Observations: 1945	S.E.	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.04	0.04	0.04	
US 1y T-bill 1y growth	AUC	0.41	0.50	0.60	0.68	0.69	0.74	0.72	0.75	0.76	0.73	0.70	0.66	0.63	0.61	0.57	0.55	0.51	0.46	0.40	0.44	
Crises: 29	high	0.51	0.59	0.70	0.79	0.79	0.83	0.81	0.85	0.86	0.83	0.79	0.75	0.70	0.69	0.65	0.61	0.58	0.53	0.53	0.55	
Countries: 28	low	0.32	0.41	0.49	0.55	0.57	0.62	0.58	0.65	0.63	0.58	0.59	0.54	0.54	0.53	0.47	0.48	0.45	0.38	0.28	0.33	
Observations: 2153	S.E.	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.04	0.04	0.05	0.03	0.04	0.04	0.06	0.06	
US 1y T-bill 3y diff.	AUC	0.30	0.31	0.39	0.44	0.49	0.56	0.59	0.64	0.68	0.72	0.75	0.75	0.74	0.75	0.74	0.71	0.69	0.64	0.58	0.57	
Crises: 29	high	0.42	0.42	0.49	0.53	0.59	0.65	0.70	0.74	0.77	0.81	0.85	0.84	0.85	0.85	0.85	0.80	0.78	0.71	0.65	0.63	
Countries: 28	low	0.20	0.22	0.29	0.34	0.38	0.45	0.48	0.52	0.58	0.61	0.64	0.60	0.60	0.61	0.59	0.59	0.58	0.56	0.50	0.49	
Observations: 1945	S.E.	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.05	0.05	0.04	0.04	0.04	
US 1y T-bill 1y diff.	AUC	0.47	0.54	0.59	0.64	0.63	0.68	0.67	0.70	0.74	0.71	0.69	0.65	0.61	0.61	0.57	0.56	0.52	0.46	0.41	0.46	
Crises: 29	high	0.57	0.61	0.68	0.72	0.72	0.76	0.76	0.78	0.84	0.80	0.78	0.73	0.68	0.68	0.64	0.62	0.59	0.54	0.52	0.56	
Countries: 28	low	0.42	0.42	0.49	0.53	0.52	0.57	0.55	0.58	0.60	0.60	0.60	0.53	0.53	0.53	0.49	0.49	0.46	0.40	0.31	0.37	
Observations: 2153	S.E.	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.06	0.05	
US 1y T-bill trend gap	AUC	0.34	0.32	0.37	0.41	0.43	0.47	0.52	0.57	0.63	0.67	0.70	0.68	0.69	0.68	0.65	0.64	0.59	0.53	0.47	0.49	
Crises: 27	high	0.46	0.41	0.46	0.48	0.50	0.55	0.61	0.67	0.72	0.77	0.80	0.79	0.78	0.79	0.75	0.73	0.67	0.60	0.56	0.58	
Countries: 28	low	0.24	0.23	0.29	0.32	0.35	0.40	0.42	0.47	0.50	0.56	0.57	0.55	0.55	0.55	0.54	0.52	0.50	0.46	0.38	0.40	
Observations: 1768	S.E.	0.06	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.04	0.04	0.05	
US 1m T-bill 3y growth	AUC	0.30	0.30	0.31	0.34	0.41	0.55	0.58	0.64	0.67	0.71	0.73	0.74	0.73	0.73	0.73	0.72	0.69	0.65	0.55	0.51	
Crises: 30	high	0.40	0.39	0.41	0.43	0.51	0.65	0.70	0.74	0.78	0.81	0.82	0.83	0.83	0.83	0.83	0.80	0.78	0.72	0.63	0.59	
Countries: 28	low	0.22	0.22	0.23	0.25	0.30	0.45	0.46	0.52	0.55	0.60	0.61	0.62	0.61	0.59	0.59	0.59	0.57	0.56	0.47	0.42	
Observations: 2366	S.E.	0.05	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.05	0.05	0.06	0.05	0.06	0.06	0.05	0.05	0.04	0.04	0.04	
US 1m T-bill 1y growth	AUC	0.36	0.43	0.49	0.59	0.63	0.67	0.69	0.73	0.75	0.73	0.71	0.66	0.63	0.60	0.58	0.54	0.53	0.45	0.36	0.38	
Crises: 30	high	0.44	0.51	0.58	0.68	0.73	0.77	0.79	0.82	0.84	0.82	0.80	0.75	0.72	0.68	0.66	0.61	0.59	0.51	0.48	0.50	
Countries: 28	low	0.28	0.35	0.39	0.49	0.51	0.57	0.56	0.60	0.60	0.60	0.60	0.56	0.55	0.52	0.49	0.48	0.46	0.39	0.26	0.26	
Observations: 2582	S.E.	0.04	0.04	0.05	0.05	0.06	0.05	0.06	0.05	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.06	0.06	
US 1m T-bill 3y diff.	AUC	0.35	0.35	0.39	0.41	0.46	0.54	0.56	0.59	0.62	0.67	0.69	0.71	0.69	0.70	0.70	0.70	0.68	0.64	0.56	0.54	
Crises: 30	high	0.44	0.44	0.48	0.50	0.55	0.61	0.64	0.68	0.72	0.76	0.78	0.78	0.78	0.80	0.81	0.78	0.76	0.71	0.64	0.61	
Countries: 28	low	0.26	0.26	0.30	0.32	0.35	0.44	0.47	0.50	0.52	0.57	0.59	0.59	0.57	0.58	0.58	0.58	0.59	0.58	0.56	0.50	0.46
Observations: 2366	S.E.	0.05	0.04	0.04	0.05	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.04	0.04	0.04
US 1m T-bill 1y diff.	AUC	0.44	0.51	0.53	0.56	0.56	0.59	0.62	0.68	0.69	0.70	0.69	0.64	0.61	0.59	0.57	0.55	0.53	0.46	0.38	0.39	
Crises: 30	high	0.52	0.57	0.61	0.63	0.65	0.67	0.70	0.77	0.79	0.78	0.76	0.72	0.68	0.66	0.65	0.62	0.59	0.51	0.47	0.50	
Countries: 28	low	0.37	0.44	0.45	0.49	0.48	0.51	0.51	0.57	0.58	0.59	0.60	0.56	0.54	0.51	0.50	0.49	0.47	0.41	0.29	0.31	
Observations: 2582	S.E.	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.05	0.05	
US 1m T-bill trend gap	AUC	0.42	0.43	0.46	0.49	0.50	0.54	0.57	0.64	0.68	0.71	0.74	0.76	0.74	0.77	0.77	0.76	0.72	0.68	0.60	0.61	
Crises: 29	high	0.52	0.51	0.54	0.57	0.58	0.61	0.65	0.72	0.76	0.79	0.81	0.85	0.83	0.86	0.86	0.83	0.79	0.74	0.67	0.69	
Countries: 28	low	0.32	0.35	0.37	0.40	0.42	0.47	0.49	0.55	0.57	0.60	0.63	0.66	0.64	0.67	0.67	0.66	0.63	0.61	0.53	0.53	
Observations: 2179	S.E.	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.03	0.04	0.04	

Panel F: Measures of the strength of bank balance sheets

	Horizon	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Leverage ratio	AUC	0.47	0.46	0.48	0.46	0.47	0.43	0.41	0.39	0.39	0.38	0.39	0.39	0.38	0.36	0.39	0.39	0.37	0.37	0.37	0.38
Crises: 11	high	0.68	0.66	0.68	0.65	0.66	0.65	0.61	0.59	0.57	0.58	0.59	0.59	0.60	0.57	0.59	0.58	0.57	0.57	0.57	0.58
Countries: 25	low	0.28	0.27	0.30	0.26	0.28	0.25	0.22	0.22	0.21	0.22	0.20	0.22	0.22	0.20	0.22	0.21	0.19	0.19	0.20	0.20
Observations: 512	S.E.	0.10	0.10	0.09	0.10	0.10	0.10	0.10	0.09	0.10	0.09	0.10	0.10	0.09	0.09	0.09	0.10	0.10	0.10	0.09	0.10
Leverage ratio 3y growth	AUC	0.34	0.31	0.36	0.36	0.37	0.25	0.27	0.22	0.24	0.26	0.34	0.35	0.34	0.33	0.38	0.36	0.34	0.44	0.47	0.50
Crises: 8	high	0.55	0.52	0.56	0.55	0.55	0.39	0.44	0.37	0.43	0.40	0.57	0.59	0.55	0.49	0.60	0.56	0.56	0.68	0.67	0.71
Countries: 20	low	0.13	0.14	0.20	0.20	0.20	0.12	0.12	0.10	0.13	0.15	0.18	0.16	0.16	0.19	0.20	0.17	0.14	0.23	0.25	0.31
Observations: 289	S.E.	0.10	0.10	0.09	0.09	0.09	0.07	0.08	0.07	0.07	0.07	0.10	0.11	0.10	0.08	0.10	0.10	0.10	0.11	0.11	0.10
Leverage ratio 1y growth	AUC	0.44	0.43	0.48	0.46	0.47	0.30	0.23	0.26	0.23	0.36	0.45	0.47	0.43	0.39	0.43	0.43	0.45	0.50	0.45	0.45
Crises: 9	high	0.60	0.61	0.70	0.68	0.64	0.43	0.35	0.47	0.38	0.57	0.68	0.69	0.66	0.61	0.57	0.59	0.68	0.68	0.66	0.66
Countries: 23	low	0.27	0.25	0.28	0.25	0.31	0.19	0.13	0.11	0.09	0.19	0.23	0.28	0.26	0.21	0.28	0.25	0.27	0.28	0.24	0.25
Observations: 434	S.E.	0.08	0.09	0.10	0.11	0.08	0.06	0.06	0.09	0.07	0.10	0.11	0.10	0.10	0.10	0.07	0.09	0.10	0.10	0.11	0.11
Leverage ratio 3y diff.	AUC	0.37	0.33	0.38	0.38	0.40	0.27	0.29	0.24	0.26	0.28	0.35	0								

Panel F: Measures of the strength of bank balance sheets

		Horizon	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Leverage ratio	AUC	0.47	0.46	0.48	0.46	0.47	0.43	0.41	0.39	0.39	0.38	0.39	0.39	0.38	0.36	0.39	0.39	0.37	0.37	0.37	0.37	0.38
Crises: 11	high	0.68	0.66	0.68	0.65	0.66	0.65	0.61	0.59	0.57	0.58	0.59	0.59	0.60	0.57	0.59	0.58	0.57	0.57	0.57	0.57	0.58
Countries: 25	low	0.28	0.27	0.30	0.26	0.28	0.25	0.22	0.22	0.21	0.22	0.20	0.22	0.22	0.20	0.22	0.21	0.19	0.19	0.20	0.20	0.20
Observations: 512	S.E.	0.10	0.10	0.09	0.10	0.10	0.10	0.10	0.09	0.10	0.09	0.10	0.09	0.10	0.09	0.09	0.10	0.10	0.10	0.10	0.09	0.10
Leverage ratio 3y growth	AUC	0.34	0.31	0.36	0.36	0.37	0.25	0.27	0.22	0.24	0.26	0.34	0.35	0.34	0.33	0.38	0.36	0.34	0.44	0.47	0.50	0.50
Crises: 8	high	0.55	0.52	0.56	0.55	0.55	0.39	0.44	0.37	0.43	0.40	0.57	0.59	0.55	0.49	0.60	0.56	0.56	0.68	0.67	0.71	0.71
Countries: 20	low	0.13	0.14	0.20	0.20	0.20	0.12	0.12	0.10	0.13	0.15	0.18	0.16	0.16	0.19	0.20	0.17	0.14	0.23	0.25	0.31	0.31
Observations: 289	S.E.	0.10	0.10	0.09	0.09	0.09	0.07	0.08	0.07	0.07	0.07	0.10	0.11	0.10	0.08	0.10	0.10	0.10	0.11	0.11	0.11	0.10
Leverage ratio 1y growth	AUC	0.44	0.43	0.48	0.46	0.47	0.30	0.23	0.26	0.23	0.36	0.45	0.47	0.43	0.39	0.43	0.43	0.45	0.50	0.45	0.45	0.45
Crises: 9	high	0.60	0.61	0.70	0.68	0.64	0.43	0.35	0.47	0.38	0.57	0.68	0.69	0.66	0.61	0.57	0.59	0.68	0.68	0.66	0.66	0.66
Countries: 23	low	0.27	0.25	0.28	0.25	0.31	0.19	0.13	0.11	0.09	0.19	0.23	0.28	0.26	0.21	0.28	0.25	0.27	0.28	0.24	0.25	0.25
Observations: 434	S.E.	0.08	0.09	0.10	0.11	0.08	0.06	0.06	0.09	0.07	0.10	0.11	0.10	0.10	0.10	0.07	0.09	0.10	0.10	0.11	0.11	0.11
Leverage ratio 3y diff.	AUC	0.37	0.33	0.38	0.38	0.40	0.27	0.29	0.24	0.26	0.28	0.35	0.36	0.36	0.34	0.40	0.38	0.36	0.44	0.47	0.50	0.50
Crises: 8	high	0.62	0.53	0.55	0.55	0.58	0.44	0.49	0.39	0.44	0.44	0.57	0.56	0.59	0.53	0.60	0.60	0.56	0.64	0.67	0.70	0.70
Countries: 20	low	0.18	0.14	0.18	0.19	0.22	0.13	0.14	0.10	0.12	0.15	0.15	0.16	0.18	0.18	0.18	0.19	0.17	0.22	0.25	0.30	0.30
Observations: 289	S.E.	0.11	0.10	0.09	0.09	0.09	0.08	0.09	0.07	0.08	0.08	0.11	0.10	0.10	0.09	0.11	0.10	0.10	0.11	0.11	0.11	0.10
Leverage ratio 1y diff.	AUC	0.46	0.44	0.49	0.46	0.48	0.32	0.26	0.28	0.25	0.38	0.47	0.50	0.45	0.42	0.45	0.43	0.45	0.49	0.44	0.45	0.45
Crises: 9	high	0.62	0.60	0.68	0.69	0.65	0.47	0.40	0.44	0.41	0.57	0.69	0.71	0.66	0.61	0.59	0.59	0.63	0.67	0.62	0.64	0.64
Countries: 23	low	0.29	0.28	0.26	0.33	0.39	0.19	0.15	0.13	0.12	0.19	0.26	0.30	0.24	0.26	0.31	0.27	0.26	0.29	0.25	0.24	0.24
Observations: 434	S.E.	0.09	0.09	0.11	0.11	0.08	0.07	0.06	0.08	0.07	0.09	0.11	0.10	0.10	0.09	0.07	0.08	0.10	0.10	0.10	0.10	0.10
Loans / deposits	AUC	0.61	0.65	0.67	0.68	0.69	0.69	0.70	0.71	0.71	0.72	0.74	0.75	0.75	0.76	0.77	0.77	0.78	0.79	0.80	0.80	0.79
Crises: 10	high	0.80	0.83	0.83	0.86	0.87	0.88	0.88	0.87	0.87	0.89	0.89	0.90	0.89	0.91	0.93	0.92	0.94	0.93	0.94	0.94	0.94
Countries: 24	low	0.36	0.41	0.44	0.45	0.46	0.47	0.49	0.47	0.48	0.48	0.54	0.54	0.53	0.55	0.55	0.54	0.58	0.57	0.59	0.60	0.60
Observations: 345	S.E.	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Loans / deposits 1y growth	AUC	0.40	0.43	0.42	0.53	0.55	0.59	0.61	0.52	0.56	0.51	0.51	0.49	0.43	0.45	0.45	0.43	0.47	0.46	0.44	0.43	0.43
Crises: 7	high	0.70	0.65	0.62	0.74	0.79	0.81	0.80	0.73	0.76	0.72	0.70	0.72	0.67	0.67	0.63	0.62	0.65	0.66	0.66	0.65	0.65
Countries: 21	low	0.21	0.26	0.22	0.35	0.33	0.36	0.39	0.32	0.37	0.32	0.30	0.26	0.23	0.26	0.30	0.26	0.33	0.27	0.26	0.23	0.23
Observations: 270	S.E.	0.12	0.10	0.10	0.10	0.12	0.10	0.11	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.08	0.09	0.08	0.10	0.10	0.10	0.11
Loans / deposits 1y diff.	AUC	0.43	0.46	0.42	0.59	0.58	0.63	0.67	0.56	0.63	0.58	0.58	0.57	0.46	0.48	0.51	0.47	0.53	0.51	0.50	0.50	0.50
Crises: 7	high	0.81	0.69	0.66	0.79	0.83	0.88	0.88	0.80	0.88	0.78	0.82	0.87	0.75	0.75	0.72	0.73	0.71	0.75	0.76	0.79	0.79
Countries: 21	low	0.24	0.26	0.23	0.34	0.27	0.36	0.42	0.34	0.38	0.35	0.32	0.29	0.22	0.23	0.35	0.24	0.36	0.27	0.27	0.24	0.24
Observations: 270	S.E.	0.14	0.11	0.11	0.11	0.14	0.13	0.12	0.12	0.12	0.11	0.13	0.15	0.14	0.13	0.09	0.12	0.09	0.12	0.12	0.14	0.14
Total assets / GDP	AUC	0.52	0.52	0.53	0.53	0.54	0.54	0.55	0.55	0.56	0.56	0.57	0.57	0.58	0.58	0.59	0.59	0.60	0.60	0.61	0.61	0.61
Crises: 10	high	0.71	0.71	0.71	0.72	0.75	0.73	0.74	0.73	0.74	0.75	0.74	0.76	0.77	0.78	0.79	0.80	0.80	0.81	0.78	0.81	0.81
Countries: 20	low	0.33	0.31	0.34	0.33	0.34	0.32	0.33	0.33	0.33	0.34	0.35	0.35	0.36	0.38	0.39	0.39	0.38	0.39	0.38	0.41	0.41
Observations: 563	S.E.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.10	0.11	0.10	0.11	0.11
Total assets / GDP 3y growth	AUC	0.60	0.59	0.52	0.54	0.55	0.55	0.59	0.57	0.60	0.61	0.58	0.59	0.64	0.71	0.74	0.75	0.78	0.79	0.80	0.80	0.83
Crises: 9	high	0.75	0.77	0.69	0.72	0.76	0.74	0.77	0.77	0.76	0.80	0.78	0.80	0.81	0.86	0.88	0.89	0.90	0.93	0.92	0.93	0.93
Countries: 18	low	0.42	0.39	0.32	0.36	0.33	0.34	0.36	0.35	0.39	0.39	0.38	0.37	0.44	0.50	0.55	0.56	0.59	0.61	0.61	0.68	0.68
Observations: 368	S.E.	0.09	0.10	0.09	0.09	0.11	0.10	0.10	0.11	0.10	0.10	0.10	0.11	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.06
Total assets / GDP 1y growth	AUC	0.60	0.60	0.47	0.46	0.49	0.63	0.68	0.63	0.66	0.68	0.63	0.62	0.67	0.69	0.75	0.76	0.80	0.76	0.76	0.76	0.76
Crises: 10	high	0.76	0.60	0.65	0.64	0.70	0.82	0.82	0.81	0.80	0.81	0.77	0.77	0.81	0.82	0.85	0.87	0.89	0.86	0.85	0.88	0.88
Countries: 20	low	0.42	0.31	0.28	0.28	0.32	0.42	0.48	0.45	0.49	0.51	0.47	0.45	0.54	0.55	0.63	0.62	0.71	0.61	0.67	0.64	0.64
Observations: 497	S.E.	0.08	0.07	0.10	0.09	0.10	0.10	0.08	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.06	0.06	0.05	0.06	0.05	0.06	0.06
Total assets / GDP 3y diff.	AUC	0.56	0.53	0.52	0.53	0.52	0.51	0.56	0.55	0.58	0.57	0.58	0.57	0.61	0.62	0.65	0.66	0.69	0.70	0.69	0.70	0.72
Crises: 9	high	0.74	0.73	0.73	0.74	0.71	0.71	0.76	0.74	0.77	0.77	0.79	0.77	0.79	0.81	0.84	0.84	0.86	0.88	0.88	0.88	0.89
Countries: 18	low	0.35	0.33	0.32	0.32	0.31	0.31	0.34	0.34	0.38	0.39	0.36	0.34	0.39	0.39	0.44	0.45	0.47	0.51	0.48		

(ST liabilities - Liquid assets) / Total assets	AUC	0.41	0.50	0.60	0.68	0.69	0.74	0.72	0.75	0.76	0.73	0.70	0.66	0.63	0.61	0.57	0.55	0.51	0.46	0.40	0.44
Crises: 6	high	0.51	0.59	0.70	0.79	0.79	0.83	0.81	0.85	0.86	0.83	0.79	0.75	0.70	0.69	0.65	0.61	0.58	0.53	0.53	0.55
Countries: 13	low	0.32	0.41	0.49	0.55	0.57	0.62	0.58	0.65	0.63	0.58	0.59	0.54	0.54	0.53	0.47	0.48	0.45	0.38	0.28	0.33
Observations: 192	S.E.	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.04	0.04	0.05	0.03	0.04	0.04	0.06	0.06
(ST liabilities - Liquid assets) / Total assets 1y diff.	AUC	0.47	0.54	0.59	0.64	0.63	0.68	0.67	0.70	0.74	0.71	0.69	0.65	0.61	0.61	0.57	0.56	0.52	0.46	0.41	0.46
Crises: 4	high	0.57	0.61	0.68	0.72	0.72	0.76	0.76	0.78	0.84	0.80	0.78	0.73	0.68	0.68	0.64	0.62	0.59	0.54	0.52	0.56
Countries: 10	low	0.38	0.46	0.49	0.55	0.52	0.57	0.55	0.58	0.60	0.60	0.60	0.53	0.53	0.53	0.49	0.49	0.46	0.40	0.31	0.37
Observations: 154	S.E.	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.06	0.05
Short-term liabilities / Liquid assets	AUC	0.34	0.32	0.37	0.41	0.43	0.47	0.52	0.57	0.63	0.67	0.70	0.68	0.69	0.68	0.65	0.64	0.59	0.53	0.47	0.49
Crises: 6	high	0.46	0.41	0.46	0.48	0.50	0.55	0.61	0.67	0.72	0.77	0.80	0.79	0.78	0.79	0.75	0.73	0.67	0.60	0.56	0.58
Countries: 13	low	0.24	0.23	0.29	0.32	0.35	0.40	0.42	0.47	0.50	0.56	0.57	0.55	0.55	0.55	0.54	0.52	0.50	0.46	0.38	0.40
Observations: 192	S.E.	0.06	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.04	0.04	0.05	0.05
Short-term liabilities / Liquid assets 1y diff.	AUC	0.36	0.43	0.49	0.59	0.63	0.67	0.69	0.73	0.75	0.73	0.71	0.66	0.63	0.60	0.58	0.54	0.53	0.45	0.36	0.38
Crises: 4	high	0.44	0.51	0.58	0.68	0.73	0.77	0.79	0.82	0.84	0.82	0.80	0.75	0.72	0.68	0.66	0.61	0.59	0.51	0.48	0.50
Countries: 10	low	0.28	0.35	0.39	0.49	0.51	0.57	0.56	0.60	0.60	0.60	0.60	0.56	0.55	0.52	0.49	0.48	0.46	0.39	0.26	0.26
Observations: 154	S.E.	0.04	0.04	0.05	0.05	0.06	0.05	0.06	0.05	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.06	0.06

Annex D: Graphs of indicators around banking crises

The graphs in this Annex depict the development of selected early warning indicators around the events in the Detken et al. crisis dataset. The horizontal time axis is set to 0 at the quarter that the banking crisis starts. The median value of the indicator value for each quarter is shown (solid) together with the 25th and 75th percentiles (dashed). The dashed horizontal lines show the 25th, 50th, and 75th percentile of the indicator variable during tranquil periods. Only those crisis events for which the indicator data spans the whole 32 quarter period are included in the graphs. The number of crises, the number of countries with included crises, and the total number of countries (some may be included only in the calculation of tranquil period median and percentiles) in each case is shown in the top right corner of the graph.

Measures of credit developments

Figure D1. Total credit (real) 1y growth.



Figure D2. Credit-to-GDP gap.

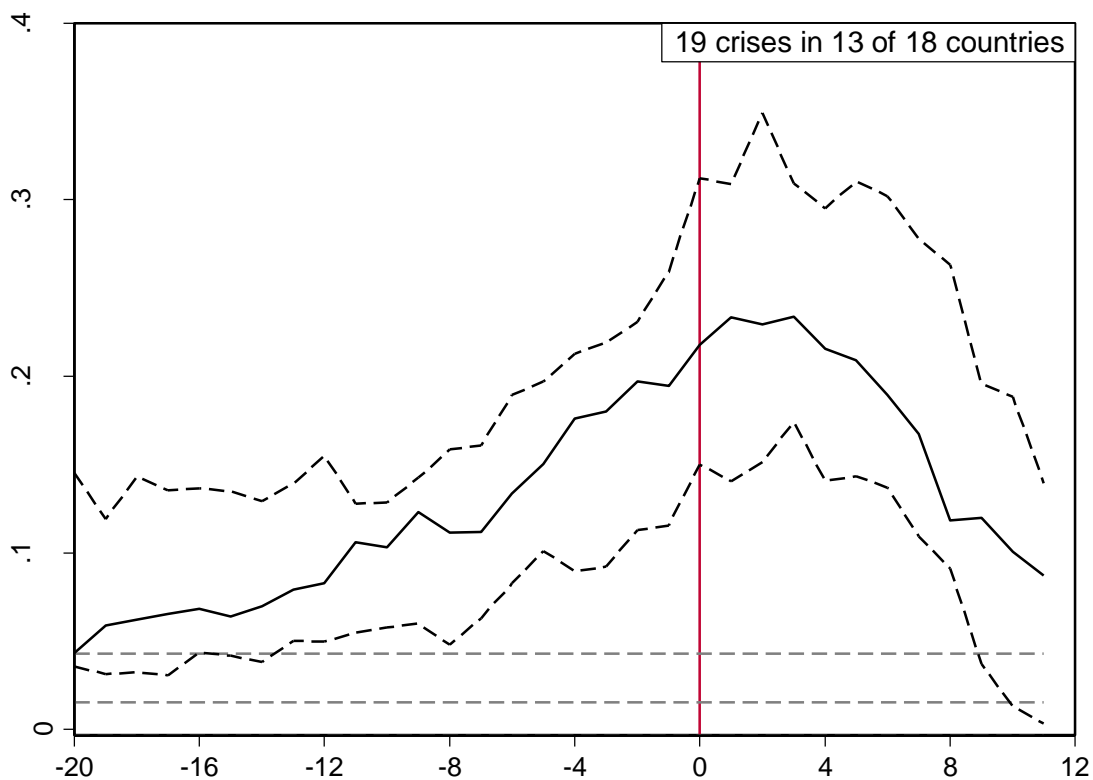


Figure D3. HH credit to GDP gap.

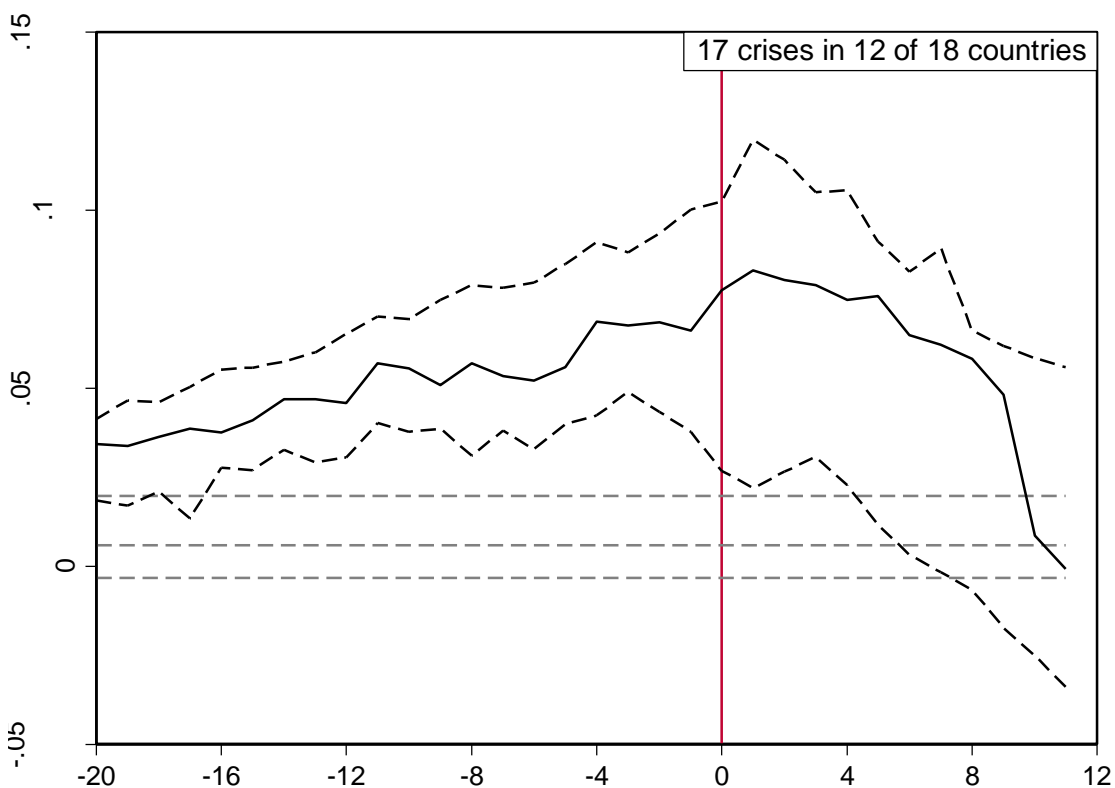
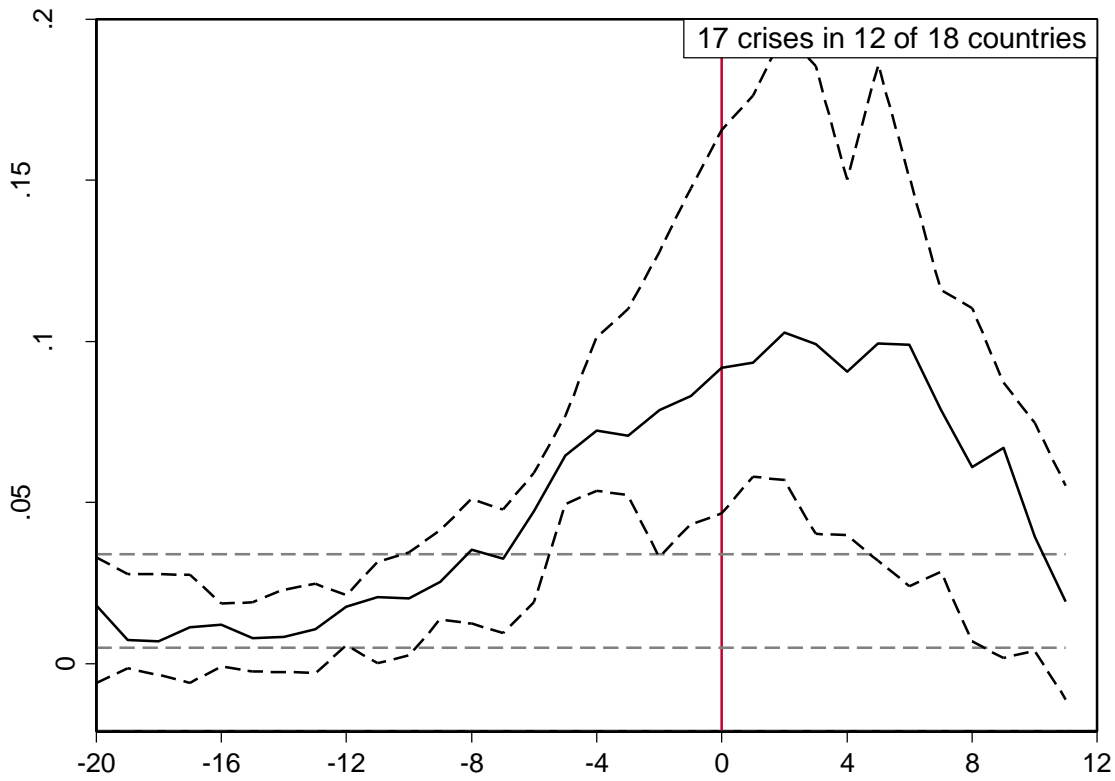


Figure D4. NFC credit to GDP gap.



Measures of private sector debt burden

Figure D5. NFC credit to GDP gap.



Figure D6. Debt-service-ratio, 1y diff. (BIS).

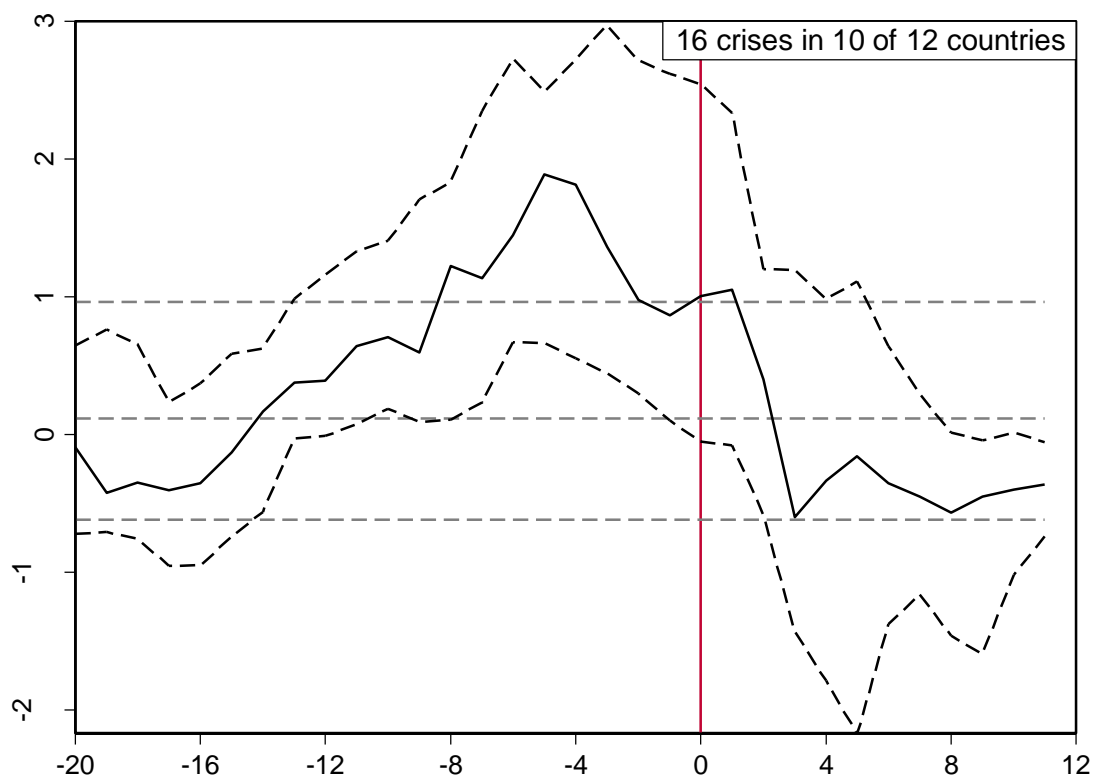


Figure D7. Debt-service-ratio, 1y diff. (ESRB) NFC credit to GDP gap.



Figure D8. HH credit * 3m interest rate / GDP, 3y diff..

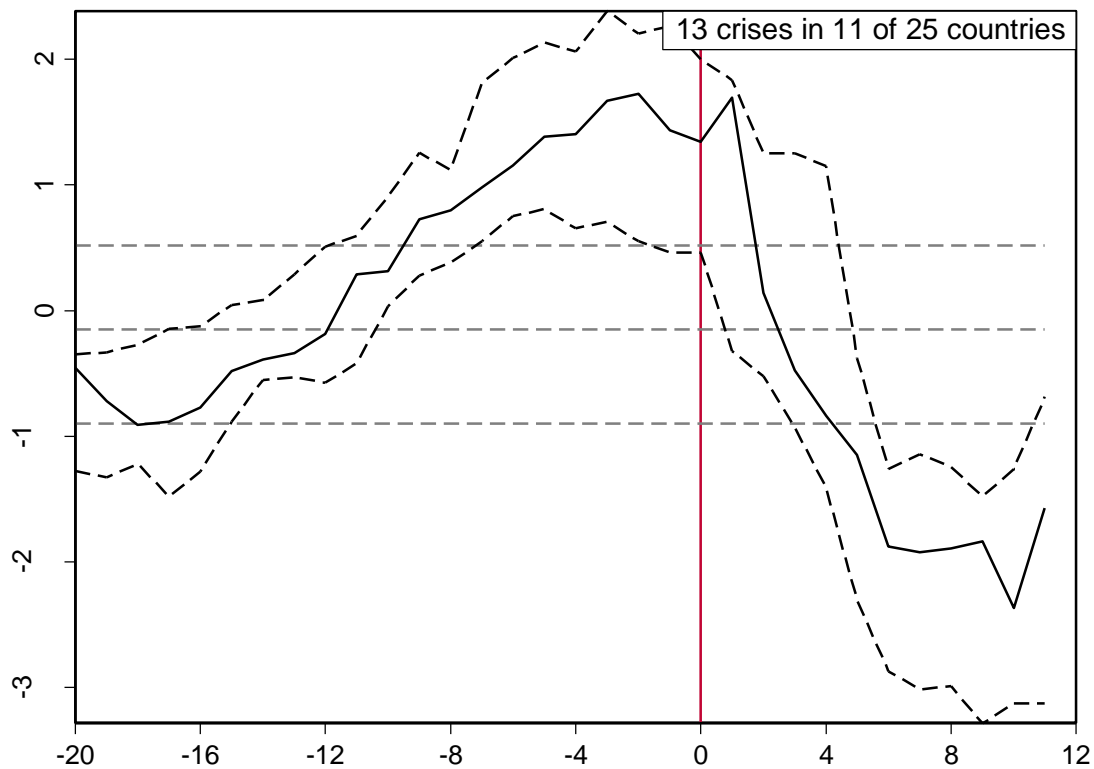
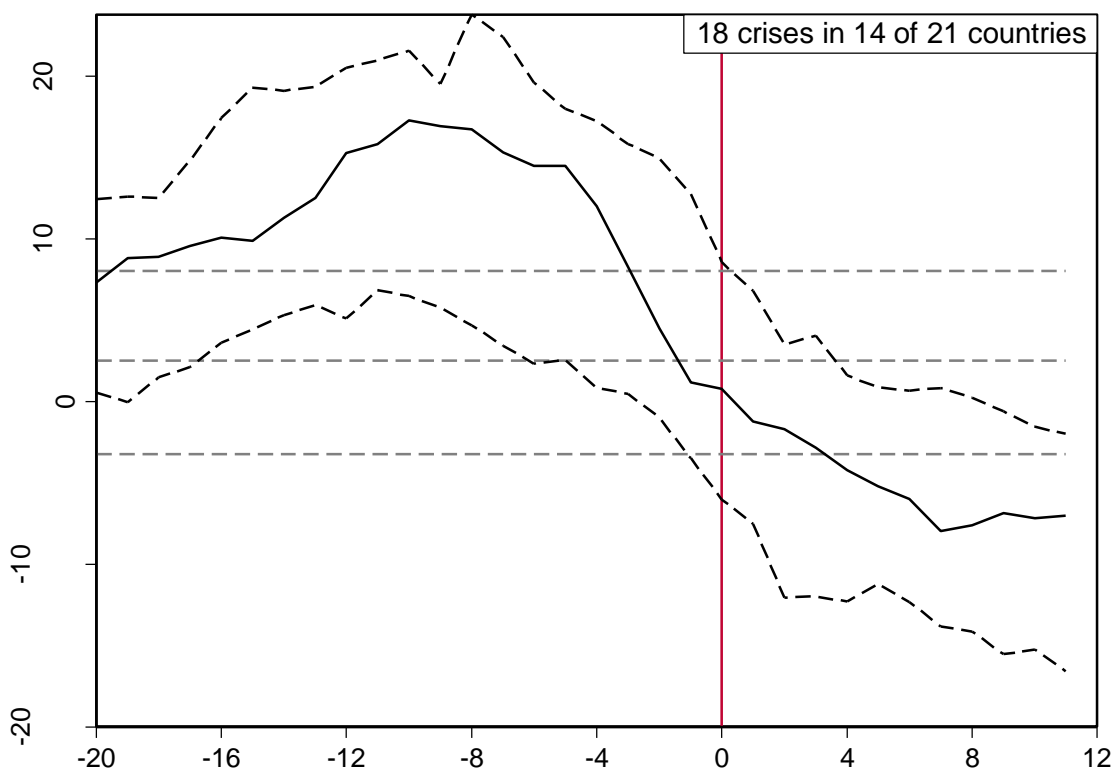


Figure D9. HH credit * 10y interest rate / GDP, 3y diff.



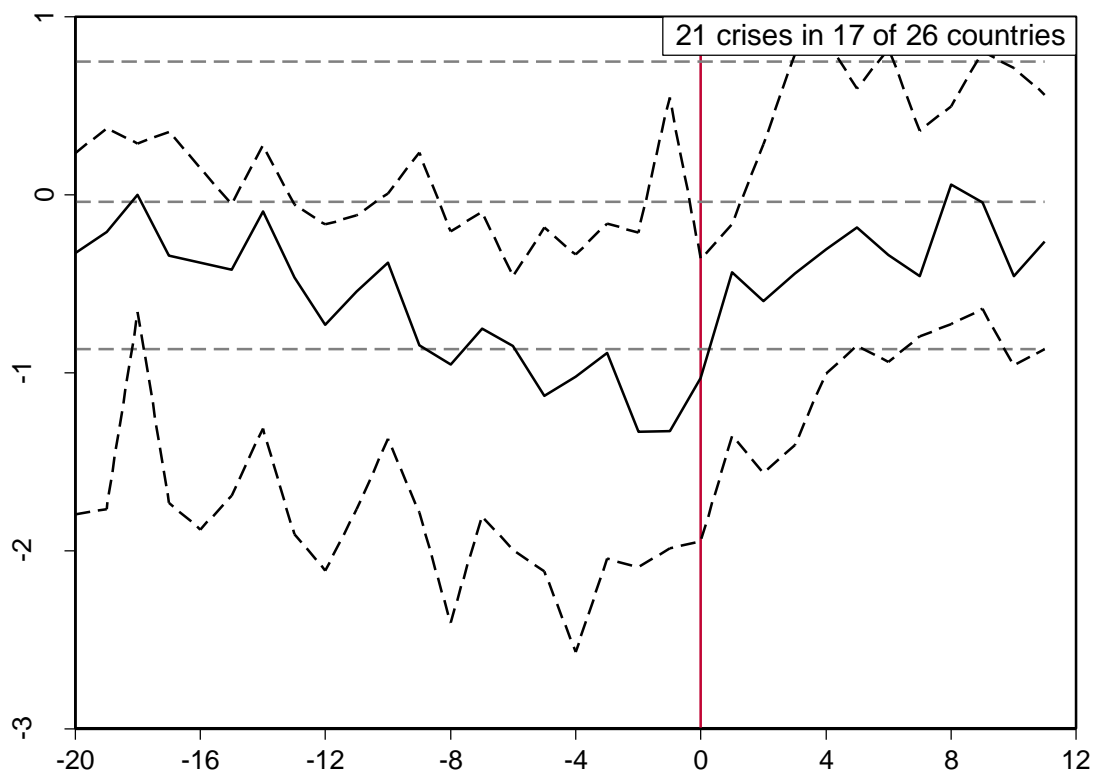
Measures of potential overvaluation of property prices

Figure D10. House price to income trend gap.



Measures of external imbalances

Figure D11. Current account to GDP, 1y diff.



Measures of potential mispricing of risk

Figure D12. Stock market index, 3y growth.

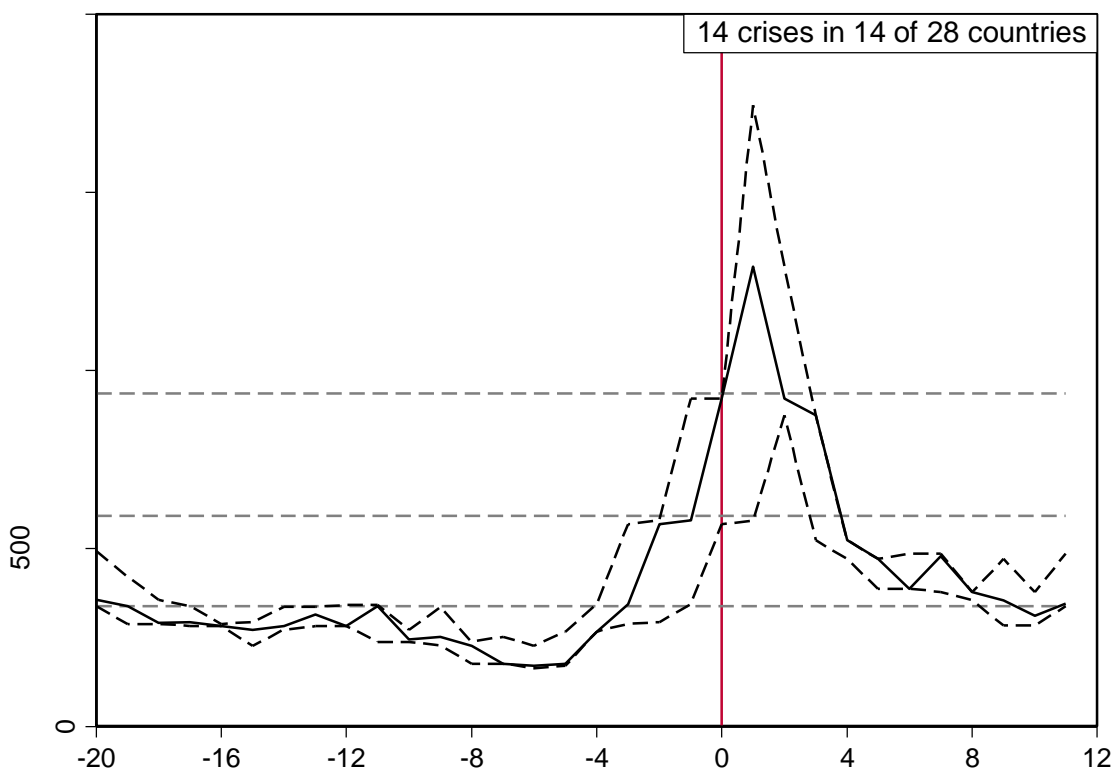


Figure D13. High yield spread.



Figure D14. CBOE volatility index (VIX).

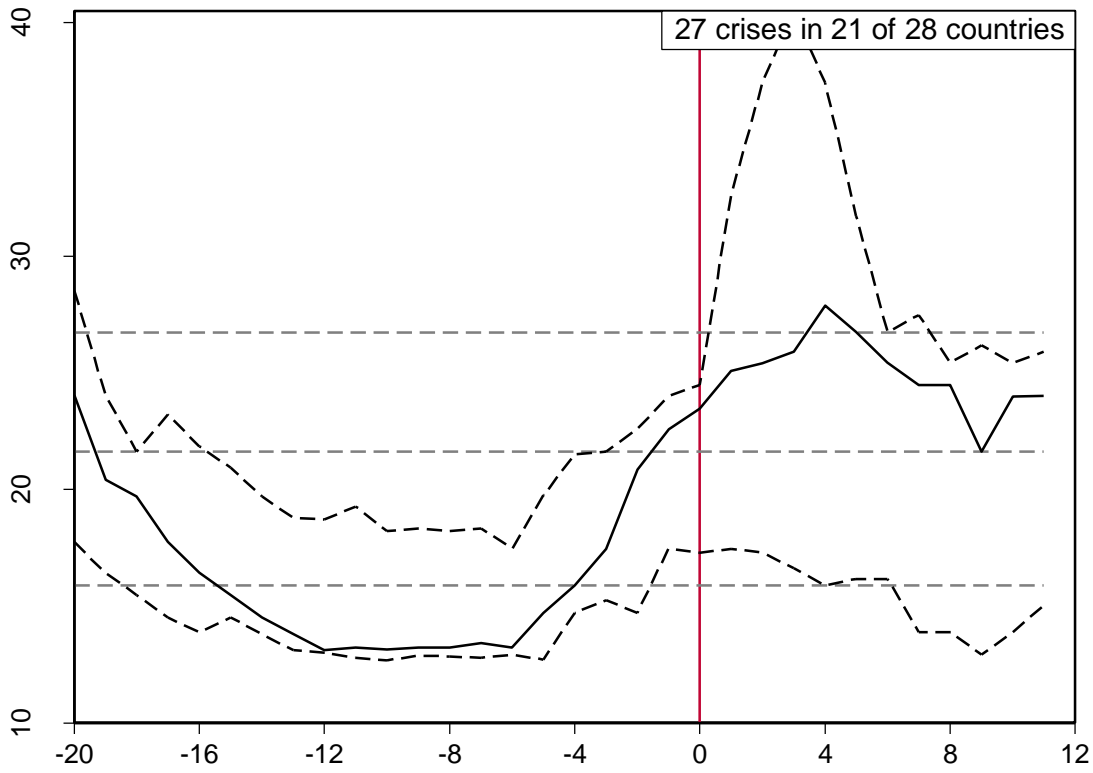


Figure D15. German 1y bill, 1y growth.



Figure D16. US 1y T-bill, 1y growth.

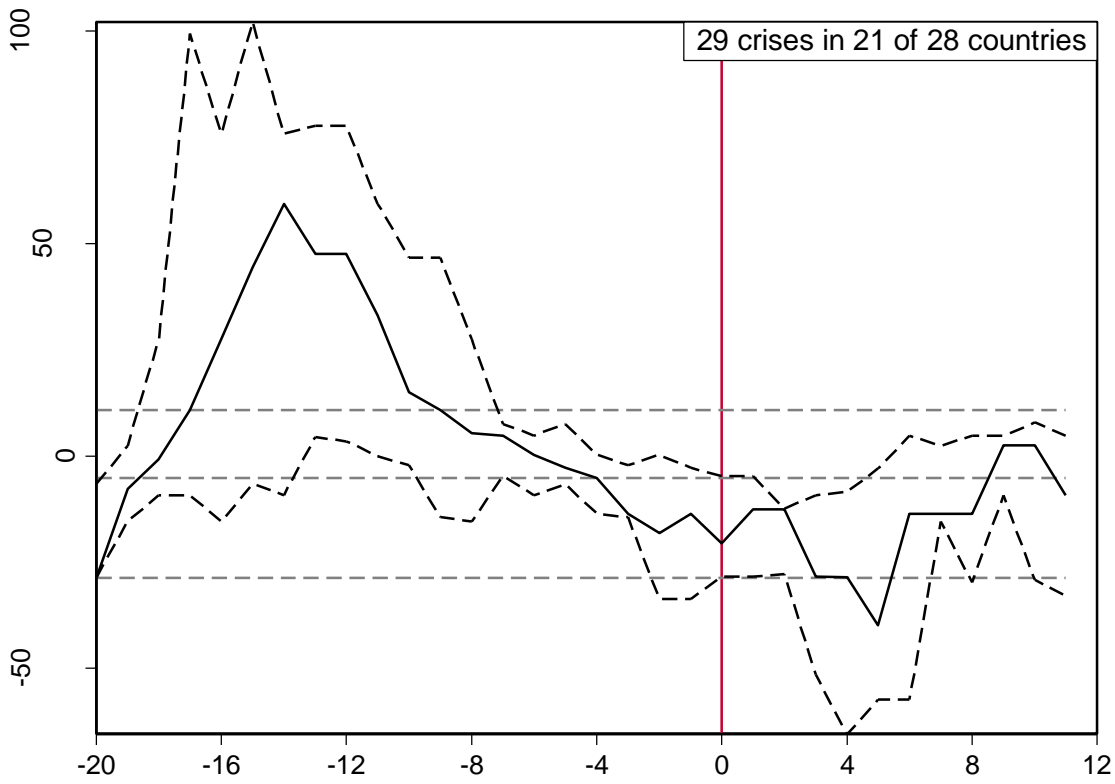


Figure D17. US 1m T-bill, trend gap.



Measures of the strength of bank balance sheets

Figure D18. Capital to liabilities, 3y growth.

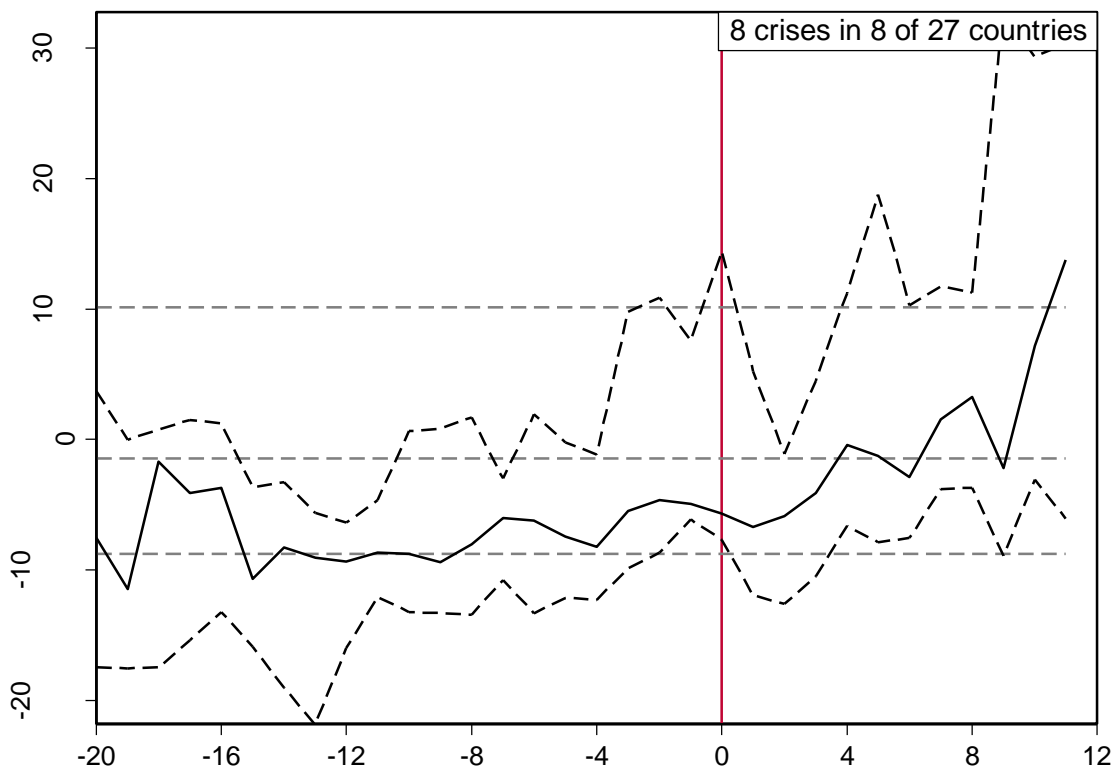


Figure D19. Loans-to-deposits ratio.



Figure D20. Total MFI assets to GDP ratio, 1y growth.



Annex E: Classification statistics and crisis probabilities.

Table E1. Classification statistics and crisis probability prediction of logit model for indicator values at percentiles calculated from pre-crisis periods 1 to 3 year prior to banking crisis with Detken et al. banking crisis dataset.

Panel A: Measures of credit developments

Indicator	Transformation	Percentile	1	10	25	50	75	90	99
Household credit (real) Crises: 12 Countries: 15 Observations: 884	3y growth	Threshold	>6.02	>14.95	>23.13	>29.98	>62.34	>89.94	>99.12
		FP rate	0.82 (0.03)	0.59 (0.07)	0.40 (0.08)	0.29 (0.08)	0.11 (0.05)	0.05 (0.03)	0.04 (0.03)
		FN rate	0.01 (0.01)	0.10 (0.07)	0.25 (0.11)	0.50 (0.11)	0.75 (0.12)	0.90 (0.08)	0.98 (0.02)
		p(crisis)	0.08 (0.02)	0.09 (0.02)	0.11 (0.02)	0.12 (0.03)	0.18 (0.05)	0.26 (0.09)	0.28 (0.10)
Household credit (real) Crises: 12 Countries: 15 Observations: 810	relative gap	Threshold	>2.00	>4.56	>9.26	>13.39	>19.34	>25.73	>42.17
		FP rate	0.66 (0.08)	0.53 (0.09)	0.41 (0.10)	0.35 (0.09)	0.19 (0.06)	0.10 (0.04)	0.01 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.06)	0.24 (0.12)	0.50 (0.13)	0.76 (0.11)	0.89 (0.08)	0.98 (0.02)
		p(crisis)	0.09 (0.03)	0.10 (0.03)	0.12 (0.03)	0.14 (0.03)	0.17 (0.04)	0.21 (0.06)	0.36 (0.13)
Total credit / GDP Crises: 20 Countries: 18 Observations: 1803	trend gap	Threshold	> 7.3e-03	>0.02	>0.06	>0.11	>0.18	>0.41	>0.61
		FP rate	0.62 (0.03)	0.44 (0.03)	0.23 (0.04)	0.12 (0.03)	0.06 (0.02)	0.00 (0.00)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.08)	0.50 (0.09)	0.75 (0.08)	0.90 (0.06)	0.99 (0.01)
		p(crisis)	0.05 (0.01)	0.06 (0.01)	0.08 (0.02)	0.14 (0.03)	0.23 (0.06)	0.75 (0.12)	0.96 (0.04)
Total bank credit / GDP Crises: 21 Countries: 18 Observations: 1884	3y diff.	Threshold	>0.03	>0.08	>0.11	>0.14	>0.22	>0.48	>0.70
		FP rate	0.78 (0.03)	0.36 (0.03)	0.17 (0.03)	0.11 (0.03)	0.04 (0.01)	0.00 (0.00)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.06)	0.50 (0.08)	0.75 (0.08)	0.90 (0.07)	0.99 (0.01)
		p(crisis)	0.04 (0.01)	0.07 (0.01)	0.09 (0.02)	0.12 (0.02)	0.25 (0.07)	0.84 (0.14)	0.98 (0.03)
Total bank credit / GDP Crises: 20 Countries: 18 Observations: 1771	trend gap	Threshold	>-0.02	>0.01	>0.04	>0.07	>0.14	>0.34	>0.49
		FP rate	0.79 (0.04)	0.45 (0.04)	0.20 (0.03)	0.12 (0.03)	0.04 (0.02)	0.00 (0.00)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.07)	0.50 (0.08)	0.75 (0.08)	0.90 (0.07)	0.99 (0.01)
		p(crisis)	0.05 (0.01)	0.07 (0.01)	0.09 (0.02)	0.12 (0.03)	0.26 (0.07)	0.83 (0.12)	0.97 (0.04)
Total bank credit / GDP Crises: 22 Countries: 18 Observations: 2040	1y diff. / 5y m.a.	Threshold	> 4.1e-03	>0.02	>0.05	>0.08	>0.12	>0.22	>0.35
		FP rate	0.93 (0.02)	0.73 (0.04)	0.24 (0.02)	0.09 (0.02)	0.02 (0.01)	0.01 (0.00)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.07)	0.50 (0.08)	0.75 (0.08)	0.90 (0.06)	0.99 (0.01)
		p(crisis)	0.04 (0.01)	0.05 (0.01)	0.08 (0.02)	0.14 (0.03)	0.27 (0.09)	0.72 (0.20)	0.97 (0.05)
Total household credit / GDP Crises: 18 Countries: 18 Observations: 1255	3y diff.	Threshold	>0.02	>0.05	>0.10	>0.13	>0.19	>0.28	>0.38
		FP rate	0.76 (0.04)	0.40 (0.04)	0.18 (0.04)	0.09 (0.03)	0.02 (0.01)	0.00 (0.00)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.07)	0.25 (0.11)	0.50 (0.13)	0.75 (0.10)	0.90 (0.07)	0.99 (0.01)
		p(crisis)	0.03 (0.01)	0.06 (0.02)	0.14 (0.03)	0.24 (0.05)	0.51 (0.08)	0.87 (0.06)	0.98 (0.01)
Total household credit / GDP Crises: 20 Countries: 18 Observations: 1385	1y diff.	Threshold	> 9.9e-04	>0.01	>0.03	>0.04	>0.07	>0.10	>0.14
		FP rate	0.92 (0.02)	0.62 (0.04)	0.29 (0.04)	0.12 (0.03)	0.03 (0.01)	0.01 (0.01)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.08)	0.50 (0.10)	0.75 (0.09)	0.90 (0.06)	0.99 (0.01)
		p(crisis)	0.04 (0.01)	0.06 (0.01)	0.11 (0.02)	0.18 (0.03)	0.36 (0.06)	0.63 (0.09)	0.92 (0.05)
Total household credit / GDP Crises: 18 Countries: 18 Observations: 1150	trend gap	Threshold	>-3.4e-03	>0.01	>0.03	>0.06	>0.08	>0.10	>0.20
		FP rate	0.79 (0.05)	0.42 (0.04)	0.21 (0.03)	0.11 (0.03)	0.05 (0.02)	0.04 (0.02)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.09)	0.50 (0.12)	0.75 (0.10)	0.90 (0.06)	0.99 (0.01)
		p(crisis)	0.06 (0.02)	0.09 (0.02)	0.14 (0.03)	0.22 (0.05)	0.33 (0.09)	0.47 (0.13)	0.92 (0.08)
Total household credit / GDP Crises: 20 Countries: 18 Observations: 1389	1y diff. / 5y m.a.	Threshold	> 1.6e-03	>0.02	>0.04	>0.06	>0.09	>0.13	>0.21
		FP rate	0.94 (0.02)	0.68 (0.05)	0.22 (0.05)	0.08 (0.03)	0.02 (0.01)	0.01 (0.00)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.06)	0.25 (0.08)	0.50 (0.11)	0.75 (0.10)	0.90 (0.06)	0.99 (0.01)
		p(crisis)	0.03 (0.01)	0.05 (0.01)	0.12 (0.02)	0.22 (0.04)	0.44 (0.09)	0.75 (0.11)	0.98 (0.02)
Total corporate credit / GDP Crises: 18 Countries: 18 Observations: 1131	trend gap	Threshold	>-0.06	>-0.02	> 9.7e-03	>0.03	>0.06	>0.13	>0.34
		FP rate	0.93 (0.03)	0.80 (0.05)	0.45 (0.06)	0.26 (0.07)	0.12 (0.04)	0.05 (0.02)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.06)	0.25 (0.07)	0.50 (0.08)	0.75 (0.08)	0.90 (0.07)	0.99 (0.01)
		p(crisis)	0.07 (0.02)	0.10 (0.02)	0.12 (0.03)	0.14 (0.03)	0.17 (0.04)	0.27 (0.09)	0.67 (0.23)

Standard errors adjusted for clustering are shown in the parentheses.

Panel B: Measures of private sector debt burden

Indicator	Transformation	Percentile	1	10	25	50	75	90	99
Household credit / Gross disposable income	3y diff.	Threshold	>-0.01	>0.15	>0.61	>2.00	>3.24	>805.19	>1077.57
Crises: 15		FP rate	0.81 (0.04)	0.58 (0.08)	0.40 (0.09)	0.10 (0.07)	0.07 (0.07)	0.01 (0.01)	0.00 (0.00)
Countries: 11		FN rate	0.01 (0.01)	0.10 (0.07)	0.24 (0.10)	0.50 (0.14)	0.75 (0.13)	0.90 (0.10)	0.99 (0.01)
Observations: 975		p(crisis)	0.12 (0.03)	0.12 (0.03)	0.12 (0.03)	0.12 (0.03)	0.12 (0.03)	0.52 (0.00)	0.69 (0.02)
Household credit / Gross disposable income	1y diff.	Threshold	> 7.4e-03	>0.10	>0.24	>0.61	>1.28	>162.41	>470.42
Crises: 15		FP rate	0.78 (0.03)	0.51 (0.10)	0.38 (0.09)	0.14 (0.07)	0.07 (0.07)	0.02 (0.02)	0.00 (0.00)
Countries: 11		FN rate	0.01 (0.01)	0.10 (0.07)	0.25 (0.11)	0.50 (0.14)	0.75 (0.13)	0.90 (0.10)	0.99 (0.01)
Observations: 1055		p(crisis)	0.12 (0.02)	0.12 (0.02)	0.12 (0.02)	0.12 (0.02)	0.12 (0.02)	0.27 (0.02)	0.73 (0.03)
Household credit / Gross disposable income	trend gap	Threshold	>-0.13	>0.05	>0.32	>1.03	>2.21	>488.91	>684.90
Crises: 15		FP rate	0.78 (0.07)	0.51 (0.07)	0.29 (0.08)	0.09 (0.05)	0.05 (0.05)	0.01 (0.01)	0.00 (0.00)
Countries: 11		FN rate	0.02 (0.01)	0.10 (0.06)	0.25 (0.11)	0.50 (0.13)	0.75 (0.13)	0.90 (0.10)	0.98 (0.01)
Observations: 905		p(crisis)	0.13 (0.03)	0.13 (0.03)	0.13 (0.03)	0.13 (0.03)	0.13 (0.03)	0.56 (0.01)	0.76 (0.02)
Debt-service-ratio (BIS)	1y growth	Threshold	>-7.25	>-0.31	>1.59	>5.35	>9.90	>13.88	>25.94
Crises: 16		FP rate	0.90 (0.02)	0.55 (0.03)	0.43 (0.03)	0.26 (0.02)	0.09 (0.02)	0.04 (0.01)	0.00 (0.00)
Countries: 12		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.06)	0.50 (0.07)	0.75 (0.07)	0.90 (0.05)	0.99 (0.01)
Observations: 1289		p(crisis)	0.04 (0.01)	0.08 (0.02)	0.09 (0.02)	0.13 (0.03)	0.20 (0.05)	0.27 (0.07)	0.57 (0.15)
Debt-service-ratio (BIS)	1y diff.	Threshold	>-1.70	>-0.08	>0.27	>1.03	>1.93	>3.06	>4.40
Crises: 16		FP rate	0.93 (0.02)	0.56 (0.03)	0.43 (0.03)	0.22 (0.03)	0.06 (0.02)	0.01 (0.01)	0.00 (0.00)
Countries: 12		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.06)	0.50 (0.09)	0.75 (0.07)	0.90 (0.05)	0.99 (0.01)
Observations: 1289		p(crisis)	0.03 (0.02)	0.08 (0.02)	0.09 (0.02)	0.14 (0.03)	0.21 (0.06)	0.34 (0.12)	0.53 (0.20)
Debt-service-ratio (ESRB)	3y growth	Threshold	>-11.72	>-3.07	>8.82	>16.29	>35.98	>80.86	>116.28
Crises: 23		FP rate	0.89 (0.03)	0.53 (0.05)	0.38 (0.05)	0.23 (0.04)	0.07 (0.03)	0.03 (0.02)	0.01 (0.01)
Countries: 25		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.06)	0.50 (0.10)	0.75 (0.08)	0.90 (0.06)	0.99 (0.01)
Observations: 1989		p(crisis)	0.06 (0.01)	0.08 (0.02)	0.09 (0.02)	0.10 (0.02)	0.14 (0.03)	0.29 (0.10)	0.46 (0.17)
Debt-service-ratio (ESRB)	1y growth	Threshold	>-4.97	>1.41	>3.33	>7.56	>13.59	>24.27	>39.02
Crises: 25		FP rate	0.88 (0.02)	0.52 (0.03)	0.39 (0.04)	0.18 (0.03)	0.08 (0.02)	0.03 (0.01)	0.01 (0.00)
Countries: 26		FN rate	0.01 (0.01)	0.10 (0.02)	0.25 (0.05)	0.50 (0.07)	0.75 (0.07)	0.90 (0.05)	0.99 (0.01)
Observations: 2185		p(crisis)	0.06 (0.02)	0.09 (0.02)	0.09 (0.02)	0.11 (0.02)	0.14 (0.03)	0.22 (0.08)	0.37 (0.18)
Debt-service-ratio (ESRB)	3y diff.	Threshold	>-0.11	> 5.0e-03	>0.01	>0.02	>0.05	>0.08	>0.22
Crises: 23		FP rate	0.99 (0.00)	0.51 (0.04)	0.35 (0.04)	0.16 (0.03)	0.04 (0.02)	0.01 (0.01)	0.00 (0.00)
Countries: 25		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.06)	0.50 (0.09)	0.75 (0.07)	0.90 (0.06)	0.99 (0.01)
Observations: 1989		p(crisis)	0.01 (0.01)	0.08 (0.02)	0.09 (0.02)	0.12 (0.02)	0.18 (0.06)	0.35 (0.16)	0.93 (0.13)
Debt-service-ratio (ESRB)	1y diff.	Threshold	>-5.6e-03	> 2.0e-03	> 5.4e-03	>0.01	>0.02	>0.04	>0.08
Crises: 25		FP rate	0.85 (0.03)	0.51 (0.03)	0.33 (0.03)	0.12 (0.02)	0.04 (0.01)	0.02 (0.01)	0.00 (0.00)
Countries: 26		FN rate	0.01 (0.01)	0.10 (0.02)	0.25 (0.05)	0.50 (0.08)	0.75 (0.07)	0.90 (0.05)	0.99 (0.01)
Observations: 2185		p(crisis)	0.05 (0.01)	0.08 (0.01)	0.09 (0.02)	0.12 (0.02)	0.20 (0.06)	0.34 (0.12)	0.83 (0.16)
Debt-service-ratio (ESRB)	trend gap	Threshold	>-0.05	> 9.5e-04	> 5.1e-03	>0.02	>0.04	>0.06	>0.16
Crises: 21		FP rate	0.98 (0.02)	0.58 (0.06)	0.46 (0.06)	0.19 (0.04)	0.04 (0.02)	0.01 (0.01)	0.00 (0.00)
Countries: 22		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.07)	0.50 (0.11)	0.75 (0.08)	0.90 (0.05)	0.99 (0.01)
Observations: 1837		p(crisis)	0.01 (0.01)	0.07 (0.02)	0.08 (0.02)	0.12 (0.02)	0.22 (0.05)	0.39 (0.12)	0.96 (0.05)
Corporate debt-service-ratio (ESRB)	1y growth	Threshold	>-5.66	>-0.60	>4.39	>8.20	>16.31	>24.44	>39.18
Crises: 17		FP rate	0.83 (0.02)	0.62 (0.04)	0.36 (0.03)	0.25 (0.03)	0.06 (0.02)	0.03 (0.01)	0.00 (0.00)
Countries: 25		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.08)	0.50 (0.11)	0.75 (0.09)	0.89 (0.06)	0.99 (0.01)
Observations: 990		p(crisis)	0.07 (0.02)	0.09 (0.03)	0.13 (0.03)	0.16 (0.04)	0.26 (0.06)	0.39 (0.11)	0.65 (0.17)
Household debt-service-ratio (ESRB)	3y diff.	Threshold	>-2.7e-03	> 4.2e-03	>0.01	>0.03	>0.05	>0.06	>0.10
Crises: 15		FP rate	0.78 (0.04)	0.64 (0.06)	0.44 (0.06)	0.10 (0.04)	0.05 (0.02)	0.01 (0.01)	0.00 (0.00)
Countries: 23		FN rate	0.01 (0.01)	0.10 (0.07)	0.25 (0.12)	0.50 (0.12)	0.75 (0.12)	0.90 (0.06)	0.99 (0.01)
Observations: 795		p(crisis)	0.05 (0.02)	0.07 (0.03)	0.11 (0.03)	0.25 (0.05)	0.42 (0.09)	0.60 (0.13)	0.88 (0.09)
Household debt-service-ratio (ESRB)	1y diff.	Threshold	>-5.6e-03	> 1.5e-03	> 5.2e-03	>0.01	>0.02	>0.03	>0.04
Crises: 18		FP rate	0.90 (0.02)	0.64 (0.04)	0.45 (0.05)	0.20 (0.04)	0.06 (0.02)	0.02 (0.01)	0.00 (0.00)
Countries: 25		FN rate	0.01 (0.01)	0.11 (0.04)	0.25 (0.08)	0.50 (0.10)	0.75 (0.09)	0.90 (0.06)	0.99 (0.01)
Observations: 976		p(crisis)	0.06 (0.02)	0.10 (0.02)	0.12 (0.03)	0.18 (0.03)	0.30 (0.06)	0.45 (0.11)	0.69 (0.14)
Household credit * 10y interest rate / GDP	3y diff.	Threshold	>-1.23	>-0.55	>0.09	>0.34	>0.76	>1.00	>1.52
Crises: 15		FP rate	0.91 (0.03)	0.74 (0.04)	0.38 (0.03)	0.24 (0.03)	0.07 (0.02)	0.03 (0.01)	0.00 (0.00)
Countries: 17		FN rate	0.01 (0.01)	0.10 (0.05)	0.24 (0.07)	0.50 (0.09)	0.75 (0.08)	0.89 (0.06)	0.98 (0.02)
Observations: 801		p(crisis)	0.04 (0.02)	0.08 (0.03)	0.15 (0.03)	0.20 (0.04)	0.29 (0.06)	0.35 (0.09)	0.50 (0.13)
Household credit * 10y interest rate / GDP	1y diff.	Threshold	>-0.91	>-0.48	>-0.17	>0.22	>0.58	>0.89	>1.17
Crises: 16		FP rate	0.98 (0.01)	0.86 (0.03)	0.63 (0.04)	0.25 (0.02)	0.07 (0.01)	0.04 (0.01)	0.02 (0.01)
Countries: 18		FN rate	0.01 (0.01)	0.10 (0.03)	0.25 (0.05)	0.50 (0.05)	0.75 (0.06)	0.90 (0.04)	0.99 (0.01)
Observations: 907		p(crisis)	0.06 (0.03)	0.09 (0.03)	0.12 (0.03)	0.17 (0.03)	0.23 (0.05)	0.29 (0.06)	0.35 (0.09)

Household credit * 3m interest rate / GDP	Threshold	>0.18	>0.89	>1.72	>2.41	>3.59	>5.07	>8.36	
Crises: 20	FP rate	0.99 (0.01)	0.81 (0.05)	0.51 (0.06)	0.34 (0.06)	0.15 (0.04)	0.02 (0.01)	0.00 (0.00)	
Countries: 25	FN rate	0.01 (0.01)	0.10 (0.06)	0.25 (0.08)	0.50 (0.09)	0.75 (0.10)	0.90 (0.05)	0.99 (0.01)	
Observations: 1350	p(crisis)	0.07 (0.03)	0.09 (0.03)	0.11 (0.02)	0.14 (0.02)	0.18 (0.03)	0.26 (0.06)	0.50 (0.18)	
Household credit * 3m interest rate / GDP	3y growth	Threshold	>-74.52	>-21.01	>2.40	>40.13	>117.45	>212.06	>548.55
Crises: 19	FP rate	0.99 (0.00)	0.60 (0.03)	0.42 (0.03)	0.24 (0.04)	0.10 (0.03)	0.03 (0.02)	0.00 (0.00)	
Countries: 25	FN rate	0.01 (0.01)	0.10 (0.03)	0.25 (0.07)	0.50 (0.07)	0.75 (0.08)	0.90 (0.07)	0.99 (0.01)	
Observations: 1087	p(crisis)	0.08 (0.02)	0.11 (0.02)	0.13 (0.02)	0.16 (0.03)	0.23 (0.05)	0.35 (0.10)	0.81 (0.17)	
Household credit * 3m interest rate / GDP	1y growth	Threshold	>-81.02	>-11.65	>4.17	>29.12	>54.08	>76.04	>172.08
Crises: 20	FP rate	0.99 (0.00)	0.65 (0.02)	0.45 (0.02)	0.19 (0.02)	0.08 (0.02)	0.04 (0.01)	0.00 (0.00)	
Countries: 25	FN rate	0.01 (0.01)	0.10 (0.03)	0.25 (0.05)	0.50 (0.06)	0.75 (0.06)	0.90 (0.05)	0.99 (0.01)	
Observations: 1262	p(crisis)	0.02 (0.01)	0.09 (0.02)	0.12 (0.02)	0.18 (0.03)	0.26 (0.05)	0.35 (0.08)	0.77 (0.14)	
Household credit * 3m interest rate / GDP	3y diff.	Threshold	>-3.14	>-0.62	>0.04	>0.74	>1.42	>2.34	>4.82
Crises: 19	FP rate	0.98 (0.01)	0.67 (0.04)	0.42 (0.03)	0.18 (0.03)	0.06 (0.02)	0.01 (0.01)	0.00 (0.00)	
Countries: 25	FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.07)	0.50 (0.07)	0.75 (0.06)	0.90 (0.03)	0.99 (0.01)	
Observations: 1087	p(crisis)	0.01 (0.01)	0.08 (0.02)	0.13 (0.03)	0.21 (0.04)	0.32 (0.07)	0.50 (0.13)	0.88 (0.11)	
Household credit * 3m interest rate / GDP	1y diff.	Threshold	>-3.98	>-0.26	>0.06	>0.45	>1.05	>1.43	>3.80
Crises: 20	FP rate	1.00 (0.00)	0.68 (0.02)	0.44 (0.02)	0.18 (0.02)	0.03 (0.01)	0.01 (0.00)	0.00 (0.00)	
Countries: 25	FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.05)	0.50 (0.06)	0.75 (0.06)	0.90 (0.04)	0.99 (0.01)	
Observations: 1262	p(crisis)	0.00 (0.00)	0.09 (0.02)	0.12 (0.02)	0.18 (0.03)	0.32 (0.07)	0.43 (0.11)	0.93 (0.08)	
Household credit * 3m interest rate / GDP	trend gap	Threshold	>-2.96	>-0.28	>0.23	>0.64	>1.17	>1.90	>3.21
Crises: 18	FP rate	1.00 (0.00)	0.74 (0.04)	0.41 (0.04)	0.22 (0.04)	0.08 (0.02)	0.01 (0.01)	0.00 (0.00)	
Countries: 25	FN rate	0.01 (0.01)	0.10 (0.06)	0.25 (0.07)	0.50 (0.08)	0.75 (0.08)	0.90 (0.05)	0.99 (0.01)	
Observations: 928	p(crisis)	0.01 (0.01)	0.09 (0.03)	0.14 (0.03)	0.20 (0.04)	0.29 (0.07)	0.45 (0.13)	0.74 (0.18)	

Standard errors adjusted for clustering are shown in the parentheses.

Panel C: Measures of potential overvaluation of property prices

Indicator	Transformation	Percentile	1	10	25	50	75	90	99
Residential property price / income		Threshold	>51.19	>72.52	>86.46	>101.93	>125.75	>141.18	>188.68
Crises: 22		FP rate	0.92 (0.04)	0.57 (0.08)	0.40 (0.09)	0.16 (0.07)	0.06 (0.05)	0.03 (0.03)	0.00 (0.00)
Countries: 21		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.07)	0.50 (0.10)	0.75 (0.10)	0.90 (0.05)	0.99 (0.01)
Observations: 1507		p(crisis)	0.05 (0.02)	0.08 (0.02)	0.11 (0.02)	0.16 (0.04)	0.26 (0.11)	0.35 (0.17)	0.67 (0.29)
Residential property price / income	3y growth	Threshold	>-8.99	>-3.99	>5.35	>20.72	>35.52	>43.66	>76.26
Crises: 20		FP rate	0.79 (0.03)	0.68 (0.03)	0.45 (0.04)	0.15 (0.03)	0.05 (0.02)	0.02 (0.01)	0.00 (0.00)
Countries: 18		FN rate	0.01 (0.01)	0.10 (0.06)	0.25 (0.08)	0.50 (0.08)	0.75 (0.08)	0.90 (0.06)	0.99 (0.01)
Observations: 1277		p(crisis)	0.06 (0.02)	0.07 (0.02)	0.10 (0.02)	0.18 (0.03)	0.31 (0.07)	0.39 (0.10)	0.73 (0.17)
Residential property price / income	1y growth	Threshold	>-9.52	>-3.17	>-0.50	>4.05	>11.61	>18.65	>35.05
Crises: 21		FP rate	0.95 (0.01)	0.75 (0.01)	0.61 (0.03)	0.34 (0.03)	0.08 (0.02)	0.03 (0.01)	0.00 (0.00)
Countries: 20		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.09)	0.50 (0.09)	0.75 (0.06)	0.90 (0.04)	0.99 (0.01)
Observations: 1430		p(crisis)	0.07 (0.02)	0.09 (0.02)	0.11 (0.02)	0.13 (0.02)	0.18 (0.03)	0.24 (0.05)	0.43 (0.14)
Residential property price / income	3y diff.	Threshold	>-12.55	>-4.12	>4.89	>16.31	>27.21	>41.85	>77.56
Crises: 20		FP rate	0.89 (0.03)	0.71 (0.04)	0.41 (0.04)	0.12 (0.03)	0.04 (0.02)	0.01 (0.01)	0.00 (0.00)
Countries: 18		FN rate	0.01 (0.01)	0.10 (0.07)	0.25 (0.08)	0.50 (0.07)	0.75 (0.09)	0.90 (0.07)	0.99 (0.01)
Observations: 1277		p(crisis)	0.03 (0.02)	0.06 (0.02)	0.10 (0.02)	0.21 (0.04)	0.36 (0.08)	0.62 (0.14)	0.95 (0.05)
Residential property price / income	1y diff.	Threshold	>-13.49	>-3.06	>-0.38	>3.80	>9.38	>17.68	>43.44
Crises: 21		FP rate	0.99 (0.01)	0.78 (0.03)	0.61 (0.03)	0.26 (0.03)	0.07 (0.02)	0.01 (0.01)	0.00 (0.00)
Countries: 20		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.08)	0.50 (0.10)	0.75 (0.08)	0.90 (0.05)	0.99 (0.01)
Observations: 1430		p(crisis)	0.04 (0.02)	0.08 (0.02)	0.10 (0.02)	0.14 (0.02)	0.20 (0.03)	0.33 (0.07)	0.80 (0.14)
Residential property price / income	trend gap	Threshold	>-6.91	>-0.77	>5.38	>15.43	>19.92	>24.33	>35.43
Crises: 19		FP rate	0.87 (0.02)	0.68 (0.04)	0.41 (0.04)	0.07 (0.03)	0.03 (0.02)	0.01 (0.01)	0.00 (0.00)
Countries: 18		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.09)	0.50 (0.06)	0.75 (0.07)	0.90 (0.05)	0.99 (0.01)
Observations: 1164		p(crisis)	0.02 (0.01)	0.05 (0.02)	0.10 (0.03)	0.29 (0.05)	0.42 (0.07)	0.55 (0.10)	0.83 (0.09)

Standard errors adjusted for clustering are shown in the parentheses.

Panel D: Measures of external imbalances

Indicator	Transformation	Percentile	1	10	25	50	75	90	99
Current account / GDP		Threshold	>-10.04	>-3.25	>-2.17	>-0.87	>-0.10	>1.46	>2.60
Crises: 22		FP rate	1.00 (0.00)	0.96 (0.02)	0.90 (0.03)	0.74 (0.06)	0.50 (0.06)	0.10 (0.03)	0.03 (0.02)
Countries: 26		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.08)	0.50 (0.10)	0.75 (0.10)	0.90 (0.05)	0.99 (0.01)
Observations: 1897		p(crisis)	0.58 (0.18)	0.19 (0.04)	0.15 (0.03)	0.11 (0.02)	0.09 (0.02)	0.06 (0.02)	0.05 (0.02)
Current account / GDP	3y growth	Threshold	>-7552.96	>-407.61	>-64.99	>14.16	>110.44	>265.15	>3672.37
Crises: 21		FP rate	1.00 (0.00)	0.95 (0.01)	0.69 (0.02)	0.36 (0.02)	0.18 (0.01)	0.08 (0.01)	0.01 (0.00)
Countries: 26		FN rate	0.01 (0.01)	0.10 (0.02)	0.25 (0.05)	0.50 (0.07)	0.75 (0.04)	0.90 (0.03)	0.99 (0.01)
Observations: 1613		p(crisis)	0.12 (0.02)	0.12 (0.02)	0.12 (0.02)	0.12 (0.02)	0.12 (0.02)	0.12 (0.02)	0.12 (0.02)
Current account / GDP	1y growth	Threshold	>-1380.46	>-76.98	>-15.92	>13.82	>49.37	>134.32	>1352.63
Crises: 22		FP rate	0.99 (0.00)	0.81 (0.02)	0.53 (0.02)	0.35 (0.01)	0.23 (0.01)	0.10 (0.01)	0.02 (0.00)
Countries: 26		FN rate	0.01 (0.01)	0.10 (0.03)	0.25 (0.05)	0.50 (0.05)	0.75 (0.04)	0.90 (0.02)	0.99 (0.00)
Observations: 1804		p(crisis)	0.11 (0.02)	0.11 (0.02)	0.11 (0.02)	0.11 (0.02)	0.11 (0.02)	0.11 (0.02)	0.11 (0.02)
Current account / GDP	3y diff.	Threshold	>-6.29	>-1.70	>-1.15	>-0.50	>0.07	>0.67	>2.27
Crises: 21		FP rate	1.00 (0.00)	0.94 (0.02)	0.88 (0.03)	0.72 (0.03)	0.46 (0.02)	0.21 (0.02)	0.03 (0.01)
Countries: 26		FN rate	0.01 (0.01)	0.10 (0.05)	0.25 (0.06)	0.50 (0.08)	0.75 (0.06)	0.90 (0.04)	0.99 (0.01)
Observations: 1614		p(crisis)	0.52 (0.20)	0.18 (0.04)	0.15 (0.03)	0.13 (0.02)	0.11 (0.02)	0.09 (0.02)	0.05 (0.02)
Current account / GDP	1y diff.	Threshold	>-4.86	>-1.07	>-0.52	>-0.21	>0.08	>0.42	>4.21
Crises: 22		FP rate	1.00 (0.00)	0.92 (0.02)	0.81 (0.03)	0.64 (0.02)	0.44 (0.01)	0.23 (0.03)	0.00 (0.00)
Countries: 26		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.05)	0.50 (0.06)	0.75 (0.04)	0.90 (0.03)	0.99 (0.01)
Observations: 1805		p(crisis)	0.30 (0.13)	0.14 (0.03)	0.12 (0.02)	0.11 (0.02)	0.10 (0.02)	0.09 (0.02)	0.04 (0.02)

Standard errors adjusted for clustering are shown in the parentheses.

Panel E: Measures of potential mispricing of risk

Indicator	Transformation	Percentile	1	10	25	50	75	90	99
Stock market index	3y growth	Threshold	>-8.09	>21.00	>41.43	>62.29	>85.60	>108.40	>172.63
Crises: 14		FP rate	0.77 (0.02)	0.55 (0.03)	0.42 (0.03)	0.31 (0.03)	0.21 (0.03)	0.14 (0.03)	0.05 (0.02)
Countries: 14		FN rate	0.01 (0.01)	0.10 (0.03)	0.25 (0.09)	0.50 (0.11)	0.75 (0.08)	0.89 (0.04)	0.98 (0.02)
Observations: 971		p(crisis)	0.09 (0.03)	0.10 (0.03)	0.11 (0.03)	0.12 (0.03)	0.13 (0.03)	0.14 (0.03)	0.18 (0.05)
Bank stock index	3y growth	Threshold	>-26.60	>3.62	>25.29	>63.15	>91.47	>142.82	>257.46
Crises: 16		FP rate	0.92 (0.02)	0.72 (0.04)	0.55 (0.04)	0.33 (0.02)	0.21 (0.02)	0.10 (0.02)	0.01 (0.01)
Countries: 13		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.09)	0.50 (0.09)	0.75 (0.09)	0.90 (0.06)	0.99 (0.01)
Observations: 1009		p(crisis)	0.11 (0.03)	0.12 (0.03)	0.13 (0.03)	0.15 (0.03)	0.16 (0.03)	0.18 (0.05)	0.25 (0.09)
Corporate lending spread	3y diff.	Threshold	<-1.85	<-0.70	<-0.39	<-0.17	<-0.03	<0.05	<0.38
Crises: 10		FP rate	0.00 (0.00)	0.00 (0.00)	0.09 (0.04)	0.34 (0.10)	0.50 (0.10)	0.58 (0.09)	0.80 (0.06)
Countries: 19		FN rate	0.98 (0.02)	0.89 (0.08)	0.74 (0.10)	0.50 (0.11)	0.26 (0.09)	0.11 (0.04)	0.00 (0.00)
Observations: 187		p(crisis)	0.97 (0.04)	0.68 (0.16)	0.50 (0.15)	0.36 (0.12)	0.29 (0.11)	0.25 (0.10)	0.13 (0.07)
High-yield spread		Threshold	<164.20	<171.20	<227.15	<252.70	<342.10	<611.90	<1129.40
Crises: 16		FP rate	0.02 (0.00)	0.03 (0.00)	0.07 (0.01)	0.12 (0.01)	0.34 (0.02)	0.57 (0.02)	0.91 (0.00)
Countries: 28		FN rate	0.91 (0.01)	0.84 (0.02)	0.75 (0.03)	0.48 (0.05)	0.20 (0.08)	0.10 (0.05)	0.01 (0.01)
Observations: 1066		p(crisis)	0.33 (0.08)	0.32 (0.08)	0.27 (0.06)	0.25 (0.05)	0.19 (0.04)	0.07 (0.03)	0.01 (0.01)
High-yield spread	3y growth	Threshold	<-79.93	<-73.39	<-60.48	<-43.20	<-36.19	<51.61	<165.24
Crises: 14		FP rate	0.08 (0.01)	0.15 (0.01)	0.35 (0.02)	0.44 (0.01)	0.50 (0.01)	0.66 (0.01)	0.91 (0.01)
Countries: 28		FN rate	0.98 (0.02)	0.89 (0.03)	0.67 (0.05)	0.48 (0.05)	0.20 (0.06)	0.07 (0.04)	0.01 (0.01)
Observations: 770		p(crisis)	0.25 (0.05)	0.24 (0.05)	0.22 (0.05)	0.20 (0.04)	0.19 (0.04)	0.11 (0.03)	0.05 (0.02)
High-yield spread	1y growth	Threshold	<-69.88	<-48.11	<-31.15	<-19.49	<14.23	<50.90	<238.43
Crises: 15		FP rate	0.05 (0.00)	0.16 (0.00)	0.27 (0.01)	0.48 (0.01)	0.69 (0.01)	0.77 (0.01)	0.93 (0.01)
Countries: 28		FN rate	0.99 (0.01)	0.88 (0.02)	0.70 (0.02)	0.47 (0.02)	0.24 (0.03)	0.06 (0.02)	0.01 (0.01)
Observations: 971		p(crisis)	0.18 (0.04)	0.17 (0.03)	0.16 (0.03)	0.15 (0.03)	0.14 (0.03)	0.12 (0.03)	0.06 (0.02)
High-yield spread	3y diff.	Threshold	<-902.70	<-751.70	<-420.90	<-161.00	<-123.20	<117.00	<602.60
Crises: 14		FP rate	0.08 (0.01)	0.19 (0.01)	0.35 (0.02)	0.48 (0.02)	0.52 (0.01)	0.59 (0.01)	0.91 (0.01)
Countries: 28		FN rate	0.98 (0.02)	0.89 (0.03)	0.67 (0.05)	0.47 (0.05)	0.27 (0.05)	0.09 (0.05)	0.01 (0.01)
Observations: 770		p(crisis)	0.21 (0.04)	0.20 (0.04)	0.18 (0.04)	0.17 (0.04)	0.16 (0.04)	0.15 (0.03)	0.13 (0.03)

CBOE Volatility Index Crises: 29 Countries: 28 Observations: 2232	Threshold	<12.58	<12.73	<12.90	<14.53	<19.83	<25.87	<33.16	
	FP rate	0.02 (0.00)	0.06 (0.00)	0.09 (0.01)	0.21 (0.01)	0.43 (0.02)	0.72 (0.01)	0.98 (0.00)	
	FN rate	0.99 (0.01)	0.91 (0.01)	0.77 (0.03)	0.49 (0.05)	0.25 (0.05)	0.10 (0.04)	0.01 (0.01)	
	p(crisis)	0.23 (0.04)	0.23 (0.04)	0.23 (0.04)	0.19 (0.03)	0.11 (0.02)	0.06 (0.02)	0.02 (0.01)	
CBOE Volatility Index Crises: 27 Countries: 28 Observations: 1908	3y growth	Threshold	<-61.94	<-61.00	<-47.21	<-27.70	<-3.26	<49.87	<147.75
		FP rate	0.00 (0.00)	0.02 (0.00)	0.06 (0.01)	0.27 (0.01)	0.49 (0.02)	0.81 (0.01)	0.97 (0.01)
		FN rate	1.00 (0.00)	0.89 (0.02)	0.74 (0.05)	0.50 (0.06)	0.27 (0.06)	0.08 (0.04)	0.01 (0.01)
		p(crisis)	0.23 (0.06)	0.23 (0.06)	0.20 (0.04)	0.16 (0.03)	0.12 (0.02)	0.07 (0.02)	0.02 (0.02)
CBOE Volatility Index Crises: 27 Countries: 28 Observations: 1908	3y diff.	Threshold	<-20.54	<-20.21	<-12.88	<-5.02	<-0.47	<6.34	<18.92
		FP rate	0.01 (0.00)	0.01 (0.00)	0.05 (0.01)	0.31 (0.02)	0.52 (0.02)	0.76 (0.01)	0.97 (0.01)
		FN rate	0.95 (0.01)	0.95 (0.01)	0.75 (0.04)	0.48 (0.07)	0.24 (0.06)	0.10 (0.04)	0.01 (0.01)
		p(crisis)	0.33 (0.09)	0.32 (0.09)	0.22 (0.05)	0.14 (0.02)	0.11 (0.02)	0.07 (0.02)	0.03 (0.02)
CBOE Volatility Index Crises: 25 Countries: 28 Observations: 1737	trend gap	Threshold	<-9.79	<-9.45	<-7.49	<-3.38	<2.72	<6.82	<10.38
		FP rate	0.01 (0.00)	0.04 (0.00)	0.12 (0.01)	0.19 (0.01)	0.48 (0.02)	0.77 (0.01)	0.96 (0.01)
		FN rate	0.96 (0.01)	0.89 (0.02)	0.76 (0.05)	0.50 (0.09)	0.25 (0.07)	0.09 (0.04)	0.01 (0.01)
		p(crisis)	0.29 (0.07)	0.28 (0.07)	0.24 (0.05)	0.17 (0.03)	0.10 (0.02)	0.06 (0.02)	0.04 (0.02)
German 1y bill Crises: 30 Countries: 28 Observations: 2423	3y growth	Threshold	>57.54	>49.08	>35.96	>16.19	>64.38	>98.22	>151.66
		FP rate	0.99 (0.00)	0.90 (0.00)	0.71 (0.01)	0.30 (0.01)	0.15 (0.01)	0.09 (0.01)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.09 (0.03)	0.23 (0.06)	0.49 (0.06)	0.74 (0.05)	0.89 (0.03)	1.00 (0.00)
		p(crisis)	0.08 (0.02)	0.08 (0.02)	0.09 (0.02)	0.11 (0.02)	0.15 (0.03)	0.17 (0.04)	0.22 (0.08)
German 1y bill Crises: 30 Countries: 28 Observations: 2639	1y growth	Threshold	>66.88	>27.45	>8.77	>12.52	>32.21	>51.34	>78.87
		FP rate	0.99 (0.00)	0.84 (0.00)	0.61 (0.01)	0.23 (0.01)	0.11 (0.00)	0.06 (0.00)	0.01 (0.00)
		FN rate	0.01 (0.01)	0.09 (0.03)	0.25 (0.07)	0.50 (0.07)	0.72 (0.04)	0.86 (0.02)	0.99 (0.01)
		p(crisis)	0.03 (0.01)	0.06 (0.01)	0.08 (0.01)	0.12 (0.02)	0.15 (0.03)	0.20 (0.05)	0.29 (0.08)
German 1y bill Crises: 30 Countries: 28 Observations: 2639	1y diff.	Threshold	>-3.38	>-1.54	>-0.49	>0.36	>1.12	>1.42	>3.05
		FP rate	0.98 (0.00)	0.84 (0.00)	0.59 (0.01)	0.29 (0.01)	0.12 (0.01)	0.09 (0.00)	0.01 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.04)	0.24 (0.06)	0.50 (0.06)	0.73 (0.04)	0.92 (0.04)	0.99 (0.01)
		p(crisis)	0.04 (0.02)	0.07 (0.02)	0.09 (0.01)	0.11 (0.02)	0.14 (0.03)	0.15 (0.03)	0.22 (0.07)
German 1m bill Crises: 30 Countries: 28 Observations: 3071	1y growth	Threshold	>78.76	>25.75	>11.38	>8.82	>39.79	>48.53	>87.72
		FP rate	0.99 (0.00)	0.82 (0.00)	0.62 (0.01)	0.35 (0.01)	0.14 (0.00)	0.11 (0.00)	0.04 (0.00)
		FN rate	0.01 (0.01)	0.09 (0.04)	0.24 (0.06)	0.50 (0.06)	0.73 (0.04)	0.86 (0.02)	0.99 (0.01)
		p(crisis)	0.05 (0.01)	0.07 (0.01)	0.08 (0.01)	0.09 (0.01)	0.11 (0.02)	0.11 (0.02)	0.14 (0.03)
US 1y T-bill Crises: 30 Countries: 28 Observations: 2423	3y growth	Threshold	>80.32	>51.84	>6.13	>46.86	>197.29	>293.61	>406.01
		FP rate	0.98 (0.00)	0.82 (0.01)	0.46 (0.01)	0.15 (0.01)	0.03 (0.01)	0.02 (0.00)	0.01 (0.00)
		FN rate	0.01 (0.01)	0.09 (0.05)	0.25 (0.07)	0.49 (0.06)	0.77 (0.04)	0.86 (0.02)	0.95 (0.01)
		p(crisis)	0.05 (0.01)	0.06 (0.01)	0.08 (0.01)	0.12 (0.02)	0.31 (0.06)	0.50 (0.10)	0.71 (0.11)
US 1y T-bill Crises: 30 Countries: 28 Observations: 2639	1y growth	Threshold	>60.97	>29.10	>8.41	>4.44	>33.19	>59.38	>179.51
		FP rate	0.99 (0.00)	0.78 (0.01)	0.56 (0.01)	0.37 (0.00)	0.15 (0.01)	0.09 (0.00)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.06)	0.49 (0.05)	0.75 (0.04)	0.89 (0.03)	1.00 (0.00)
		p(crisis)	0.07 (0.01)	0.08 (0.01)	0.10 (0.01)	0.10 (0.02)	0.12 (0.02)	0.14 (0.03)	0.26 (0.08)
US 1y T-bill Crises: 30 Countries: 28 Observations: 2423	3y diff.	Threshold	>-5.82	>-4.24	>-0.45	>1.98	>3.21	>3.89	>4.50
		FP rate	0.98 (0.00)	0.82 (0.01)	0.46 (0.01)	0.16 (0.01)	0.05 (0.01)	0.02 (0.00)	0.01 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.07)	0.49 (0.06)	0.71 (0.04)	0.86 (0.02)	0.95 (0.01)
		p(crisis)	0.02 (0.01)	0.03 (0.02)	0.10 (0.02)	0.19 (0.03)	0.25 (0.05)	0.29 (0.06)	0.32 (0.08)
US 1y T-bill Crises: 30 Countries: 28 Observations: 2639	1y diff.	Threshold	>-3.50	>-1.96	>-0.54	>0.28	>1.49	>1.80	>3.52
		FP rate	0.95 (0.00)	0.79 (0.00)	0.55 (0.01)	0.36 (0.00)	0.16 (0.00)	0.10 (0.00)	0.01 (0.00)
		FN rate	0.01 (0.00)	0.11 (0.03)	0.25 (0.05)	0.51 (0.06)	0.79 (0.03)	0.90 (0.02)	1.00 (0.00)
		p(crisis)	0.05 (0.01)	0.07 (0.01)	0.10 (0.01)	0.11 (0.02)	0.14 (0.02)	0.15 (0.03)	0.20 (0.04)
US 1y T-bill Crises: 29 Countries: 28 Observations: 2232	trend gap	Threshold	>-2.07	>-1.09	>1.27	>1.88	>2.45	>2.71	>3.87
		FP rate	1.00 (0.00)	0.81 (0.01)	0.49 (0.01)	0.24 (0.00)	0.09 (0.00)	0.06 (0.00)	0.01 (0.00)
		FN rate	0.00 (0.00)	0.09 (0.05)	0.25 (0.07)	0.50 (0.06)	0.73 (0.04)	0.87 (0.02)	0.98 (0.01)
		p(crisis)	0.04 (0.02)	0.05 (0.02)	0.12 (0.02)	0.15 (0.02)	0.19 (0.03)	0.20 (0.04)	0.29 (0.09)
US 1m T-bill Crises: 30 Countries: 28 Observations: 2855	3y growth	Threshold	>86.45	>58.36	>7.20	>53.08	>265.05	>367.34	>393.00
		FP rate	0.99 (0.00)	0.83 (0.01)	0.48 (0.01)	0.16 (0.01)	0.03 (0.01)	0.02 (0.00)	0.00 (0.00)
		FN rate	0.01 (0.01)	0.09 (0.05)	0.25 (0.07)	0.49 (0.06)	0.74 (0.04)	0.86 (0.02)	1.00 (0.00)
		p(crisis)	0.04 (0.01)	0.05 (0.01)	0.07 (0.01)	0.10 (0.02)	0.34 (0.07)	0.52 (0.10)	0.56 (0.11)
US 1m T-bill Crises: 30 Countries: 28 Observations: 3071	1y growth	Threshold	>73.10	>31.01	>8.87	>8.38	>40.57	>82.60	>161.30
		FP rate	0.99 (0.00)	0.80 (0.01)	0.56 (0.00)	0.32 (0.00)	0.15 (0.00)	0.07 (0.00)	0.01 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.06)	0.50 (0.06)	0.77 (0.04)	0.89 (0.02)	0.99 (0.01)
		p(crisis)	0.05 (0.01)	0.07 (0.01)	0.08 (0.01)	0.09 (0.01)	0.11 (0.02)	0.15 (0.03)	0.24 (0.07)
US 1m T-bill Crises: 30 Countries: 28 Observations: 2855	3y diff.	Threshold	>-5.88	>-4.97	>-0.41	>2.08	>3.73	>4.20	>4.25
		FP rate	0.96 (0.00)	0.87 (0.00)	0.47 (0.01)	0.19 (0.01)	0.09 (0.01)	0.07 (0.00)	0.06 (0.00)
		FN rate	0.01 (0.01)	0.09 (0.04)	0.25 (0.07)	0.49 (0.06)	0.74 (0.04)	0.86 (0.02)	0.96 (0.01)
		p(crisis)	0.04 (0.01)	0.05 (0.01)	0.09 (0.01)	0.13 (0.02)	0.15 (0.03)	0.16 (0.03)	0.16 (0.03)
US 1m T-bill Crises: 30 Countries: 28 Observations: 3071	1y diff.	Threshold	>-3.49	>-1.86	>-0.60	>0.53	>1.69	>1.99	>3.28
		FP rate	0.92 (0.00)	0.79 (0.00)	0.59 (0.01)	0.33 (0.00)	0.17 (0.00)	0.12 (0.00)	0.07 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.03)	0.23 (0.05)	0.50 (0.06)	0.75 (0.04)	0.88 (0.02)	0.99 (0.01)
		p(crisis)	0.07 (0.01)	0.08 (0.01)	0.08 (0.01)	0.09 (0.01)	0.10 (0.02)	0.10 (0.02)	0.12 (0.02)
US 1m T-bill Crises: 30 Countries: 28 Observations: 2666	trend gap	Threshold	>-2.69	>-1.73	>0.43	>1.83	>2.77	>2.99	>3.10
		FP rate	0.91 (0.00)	0.75 (0.01)	0.44 (0.01)	0.18 (0.01)	0.03 (0.00)	0.02 (0.00)	0.01 (0.00)
		FN rate	0.01 (0.01)	0.10 (0.04)	0.25 (0.07)	0.50 (0.06)	0.78 (0.04)	0.86 (0.02)	0.95 (0.01)
		p(crisis)	0.02 (0.01)	0.04 (0.02)	0.10 (0.02)	0.17 (0.03)	0.24 (0.05)	0.25 (0.05)	0.26 (0.05)

Standard errors adjusted for clustering are shown in the parentheses.

Panel F: Measures of the strength of bank balance sheets

Indicator	Transformation	Percentile	1	10	25	50	75	90	99
Leverage ratio		Threshold	<4.35	<4.72	<6.05	<7.27	<8.62	<9.05	<9.65
Crises: 14		FP rate	0.04 (0.02)	0.09 (0.05)	0.27 (0.10)	0.35 (0.10)	0.59 (0.09)	0.67 (0.09)	0.72 (0.08)
Countries: 26		FN rate	0.98 (0.02)	0.89 (0.06)	0.74 (0.14)	0.50 (0.14)	0.25 (0.11)	0.10 (0.05)	0.01 (0.01)
Observations: 719		p(crisis)	0.27 (0.11)	0.25 (0.10)	0.21 (0.07)	0.18 (0.04)	0.15 (0.03)	0.14 (0.03)	0.12 (0.03)
Leverage ratio	3y growth	Threshold	<-36.12	<-20.41	<-14.37	<-8.29	<-4.28	<4.46	<33.93
Crises: 12		FP rate	0.00 (0.00)	0.08 (0.03)	0.18 (0.06)	0.30 (0.07)	0.43 (0.07)	0.69 (0.06)	0.93 (0.04)
Countries: 25		FN rate	1.00 (0.00)	0.90 (0.05)	0.75 (0.08)	0.50 (0.11)	0.25 (0.08)	0.09 (0.07)	0.00 (0.00)
Observations: 444		p(crisis)	0.53 (0.18)	0.36 (0.10)	0.30 (0.07)	0.25 (0.06)	0.22 (0.05)	0.16 (0.06)	0.05 (0.05)
Leverage ratio	1y growth	Threshold	<-17.08	<-9.88	<-7.02	<-3.60	<2.57	<6.30	<27.33
Crises: 13		FP rate	0.02 (0.01)	0.10 (0.02)	0.19 (0.03)	0.32 (0.04)	0.67 (0.04)	0.79 (0.03)	0.97 (0.01)
Countries: 26		FN rate	0.99 (0.01)	0.90 (0.04)	0.75 (0.05)	0.50 (0.05)	0.25 (0.06)	0.09 (0.04)	0.01 (0.01)
Observations: 628		p(crisis)	0.28 (0.08)	0.23 (0.06)	0.22 (0.05)	0.20 (0.04)	0.17 (0.04)	0.15 (0.05)	0.09 (0.06)
Leverage ratio	3y diff.	Threshold	<-4.51	<-1.64	<-1.05	<-0.68	<-0.29	<0.22	<1.87
Crises: 12		FP rate	0.00 (0.00)	0.11 (0.04)	0.20 (0.06)	0.28 (0.07)	0.43 (0.07)	0.66 (0.06)	0.90 (0.04)
Countries: 25		FN rate	0.99 (0.01)	0.90 (0.05)	0.75 (0.08)	0.50 (0.10)	0.25 (0.10)	0.10 (0.07)	0.00 (0.00)
Observations: 444		p(crisis)	0.57 (0.24)	0.31 (0.09)	0.26 (0.06)	0.24 (0.06)	0.21 (0.05)	0.18 (0.05)	0.10 (0.06)
Leverage ratio	1y diff.	Threshold	<-1.68	<-0.87	<-0.53	<-0.24	<0.15	<0.46	<1.42
Crises: 13		FP rate	0.02 (0.01)	0.11 (0.03)	0.21 (0.04)	0.36 (0.05)	0.64 (0.04)	0.81 (0.02)	0.94 (0.02)
Countries: 26		FN rate	0.99 (0.01)	0.90 (0.04)	0.75 (0.06)	0.50 (0.06)	0.25 (0.06)	0.09 (0.05)	0.02 (0.02)
Observations: 628		p(crisis)	0.28 (0.08)	0.23 (0.05)	0.21 (0.05)	0.19 (0.04)	0.17 (0.04)	0.16 (0.04)	0.12 (0.05)
Loans / deposits		Threshold	>78.03	>102.73	>117.19	>133.81	>170.36	>253.19	>308.73
Crises: 12		FP rate	0.84 (0.06)	0.64 (0.10)	0.54 (0.10)	0.36 (0.10)	0.08 (0.05)	0.02 (0.02)	0.00 (0.00)
Countries: 26		FN rate	0.01 (0.01)	0.10 (0.08)	0.25 (0.11)	0.50 (0.13)	0.75 (0.13)	0.89 (0.08)	0.98 (0.02)
Observations: 537		p(crisis)	0.12 (0.04)	0.15 (0.05)	0.17 (0.05)	0.20 (0.05)	0.28 (0.05)	0.49 (0.10)	0.64 (0.13)
Loans / deposits	1y growth	Threshold	>-3.40	>-2.03	>-0.17	>3.74	>8.25	>16.71	>25.14
Crises: 12		FP rate	0.86 (0.03)	0.81 (0.04)	0.68 (0.06)	0.43 (0.07)	0.27 (0.07)	0.08 (0.03)	0.01 (0.01)
Countries: 26		FN rate	0.01 (0.01)	0.09 (0.06)	0.25 (0.09)	0.50 (0.11)	0.74 (0.11)	0.90 (0.06)	0.98 (0.02)
Observations: 446		p(crisis)	0.22 (0.07)	0.22 (0.06)	0.23 (0.06)	0.24 (0.06)	0.26 (0.06)	0.29 (0.10)	0.32 (0.15)
Loans / deposits	1y diff.	Threshold	>-8.28	>-3.06	>-0.23	>5.60	>11.69	>19.10	>26.32
Crises: 12		FP rate	0.94 (0.02)	0.83 (0.03)	0.68 (0.06)	0.37 (0.06)	0.16 (0.05)	0.06 (0.03)	0.02 (0.01)
Countries: 26		FN rate	0.01 (0.01)	0.09 (0.05)	0.25 (0.09)	0.50 (0.11)	0.74 (0.09)	0.91 (0.06)	0.99 (0.01)
Observations: 446		p(crisis)	0.16 (0.07)	0.19 (0.06)	0.21 (0.06)	0.25 (0.06)	0.29 (0.07)	0.36 (0.11)	0.42 (0.15)
Total assets / GDP	3y growth	Threshold	>4.08	>12.83	>18.52	>31.75	>44.02	>55.41	>77.89
Crises: 12		FP rate	0.90 (0.03)	0.67 (0.08)	0.56 (0.08)	0.23 (0.06)	0.12 (0.05)	0.04 (0.03)	0.01 (0.01)
Countries: 20		FN rate	0.00 (0.00)	0.11 (0.06)	0.24 (0.09)	0.50 (0.11)	0.74 (0.12)	0.89 (0.10)	0.99 (0.01)
Observations: 526		p(crisis)	0.10 (0.04)	0.12 (0.05)	0.14 (0.05)	0.20 (0.05)	0.26 (0.07)	0.33 (0.09)	0.49 (0.16)
Total assets / GDP	1y growth	Threshold	>-2.05	>4.78	>7.64	>10.72	>14.42	>16.82	>23.41
Crises: 13		FP rate	0.90 (0.02)	0.59 (0.05)	0.43 (0.05)	0.28 (0.05)	0.17 (0.04)	0.12 (0.04)	0.03 (0.01)
Countries: 21		FN rate	0.01 (0.01)	0.10 (0.06)	0.24 (0.08)	0.50 (0.08)	0.76 (0.09)	0.89 (0.05)	0.98 (0.02)
Observations: 678		p(crisis)	0.09 (0.03)	0.13 (0.04)	0.15 (0.04)	0.18 (0.05)	0.22 (0.06)	0.25 (0.06)	0.34 (0.10)
Total assets / GDP	3y diff.	Threshold	> 1.1e-03	>0.04	>0.10	>0.40	>0.86	>1.95	>3.53
Crises: 12		FP rate	0.89 (0.06)	0.79 (0.08)	0.69 (0.11)	0.32 (0.08)	0.15 (0.08)	0.07 (0.06)	0.03 (0.02)
Countries: 20		FN rate	0.01 (0.01)	0.10 (0.10)	0.24 (0.13)	0.50 (0.15)	0.74 (0.12)	0.90 (0.10)	0.99 (0.01)
Observations: 526		p(crisis)	0.17 (0.05)	0.17 (0.05)	0.17 (0.05)	0.18 (0.05)	0.18 (0.05)	0.20 (0.08)	0.22 (0.16)
Total assets / GDP	1y diff.	Threshold	>-0.06	> 7.3e-03	>0.06	>0.16	>0.35	>0.76	>1.36
Crises: 13		FP rate	0.94 (0.03)	0.71 (0.07)	0.50 (0.08)	0.29 (0.06)	0.14 (0.06)	0.06 (0.05)	0.03 (0.03)
Countries: 21		FN rate	0.01 (0.01)	0.11 (0.08)	0.24 (0.11)	0.50 (0.12)	0.75 (0.11)	0.89 (0.08)	0.99 (0.01)
Observations: 678		p(crisis)	0.15 (0.04)	0.16 (0.04)	0.16 (0.04)	0.16 (0.04)	0.17 (0.04)	0.18 (0.06)	0.20 (0.09)

Standard errors adjusted for clustering are shown in the parentheses.

Recent Bank of Finland Research Discussion Papers

ISSN 1456-6184, online

- 1/2015 Karlo Kauko **The net stable funding ratio requirement when money is endogenous.** 2015. 9 p. ISBN 978-952-323-023-1, online.
- 2/2015 Boele Bonthuis – Valerie Jarvis – Juuso Vanhala **Shifts in euro area Beveridge curves and their determinants.** 2015. 35 p. ISBN 978-952-323-024-8, online.
- 3/2015 Iftekhar Hasan – Nadia Massoud – Anthony Saunders – Keke Song **Which financial stocks did short sellers target in the subprime crisis?** 2015. 58 p. ISBN 978-952-323-028-6, online.
- 4/2015 Helinä Laakkonen **Relevance of uncertainty on the volatility and trading volume in the US Treasury bond futures market.** 2015. 26 p. ISBN 978-952-323-017-0, online.
- 5/2015 Esa Jokivuolle – Jussi Keppo – Xuchuan Yuan **Bonus caps, deferrals and bankers' risk-taking.** 2015. 50 p. ISBN 978-952-323-029-3, online.
- 6/2015 Markus Holopainen – Peter Sarlin **Toward robust early-warning models: A horse race, ensembles and model uncertainty.** 2015. 34 p. ISBN 978-952-323-027-9, online.
- 7/2015 Jarkko Huotari **Measuring financial stress – A country specific stress index for Finland.** 2015. 41 p. ISBN 978-952-323-034-7, online.
- 8/2015 Simo Kalatie – Helinä Laakkonen – Eero Tölö **Indicators used in setting the countercyclical capital buffer.** 2015. 85 p. ISBN 978-952-323-035-4, online.

